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June 15, 1989

Energy Research Abstracts

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UNITED STATES DEPARTMENT OF ENERGY

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ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Department of Energy's Scientific and Technical Information Program (STIP) is carried out at many levels within the Department and by its contractor organizations. The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, provides direction and leadership for STIP and serves as DOE's national center for scientific and technical information management and dissemination. Both DOE-originated information and worldwide literature regarding advances in subjects of interest to DOE researchers are collected, processed, and disseminated through the Energy Data Information System (EDIS) maintained by OSTI. The major data bases in this system are available within the United States through commercial on-line systems and to those outside the United States through formal governmental exchange agreements. The current-year records for the major data bases plus a number of specialized data bases are available to DOE offices and contractors through OSTI's Integrated Technical Information System (ITIS). To manage DOE's information resources effectively, DOE's Scientific and Technical Information Program is one of continual development and evaluation of new information products, systems, and technologies.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. Foreign information is obtained through the International Energy Agency's 13-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. **Please note that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

ERA is comprehensive in its subject scope, encompassing DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

Information in *ERA* is available for on-line searching as part of the Energy Data Base. The current-year records are available on the Integrated Technical Information System (ITIS). The entire data base is available through commercial on-line vendors.

DOE and DOE contractors who have OSTI deposit accounts can obtain *ERA* from the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831, Attention: Information Services. For further information, call (615)576-8401, FTS 626-8401. *ERA* is also available at authorized Depository Libraries.

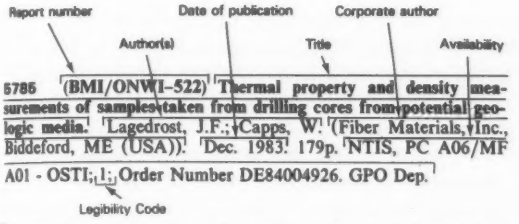
ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for 24 semimonthly issues is $184.00 for domestic subscribers and $230.00 for foreign subscribers. A single issue costs $27.00, domestic, or $33.75, foreign. Cumulative indexes are available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The GPO Stock Number is 661-000-00000-7 and the price is $174.00 for the Volume 13 indexes.

Managing Editor, Audrey B. Smith
Technical Editor, M. Catherine Grissom

Office of Scientific and Technical Information
United States Department of Energy, P. O. Box 62, Oak Ridge, TN 37831

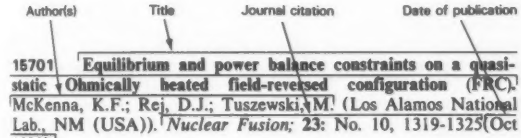
ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI–522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01 - OSTI; 1; Order Number DE84004926. GPO Dep.

Abstract: Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23**: No. 10, 1319-1325 (Oct 1983).

Abstract: Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI–522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830 **Fiber Materials, Inc., Biddeford, ME (USA)** 9:5785 BMI/ONWI–522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

BMI/ONWI–522 9:5785 NTIS, PC A09/MF A01. OSTI Order Number DE84004926, Distribution Category MN-70

INFORMATION SOURCES

The citations presented in *Energy Research Abstracts* are a subset of the worldwide energy information provided to the Office of Scientific and Technical Information (OSTI) through exchange agreements with foreign sources and through exchanges or contracts with U.S. organizations.

The **Energy Technology Data Exchange (ETDE)** was established by the International Energy Agency to promote cooperation among members in conducting appropriate energy-related research and development programs through the development of a formal central information sharing system. In accomplishing the objectives of the ETDE, members select, abstract, and index relevant research information published in their countries in accordance with Exchange standards. OSTI serves as the central receiving and processing center for this information, which it then disseminates to national centers in the participating countries. The following countries are currently members of the ETDE:

Canada
Denmark
Finland
France
Federal Republic of Germany
Italy
Japan
The Netherlands
Norway
Spain
Sweden
United Kingdom
United States

The **International Nuclear Information System (INIS)** was established to promote the exchange of information on nuclear science and technology. Its operation is similar to that of the ETDE, with the INIS Secretariat being located in Vienna, Austria. Currently, 75 countries and 14 international organizations are members of INIS. OSTI serves as the INIS national center for the United States.

In the exercise of its rights and responsibilities under the agreements to which it is a party, OSTI both receives information from the above sources and submits U.S.-produced information to them. In addition to materials generated by the Department of Energy, this U.S.-produced information is gathered from other government agencies as well as under contract with private information processing companies. All input is computer processed and entered into a data base for on-line retrieval. The data base serves as well for the production of numerous OSTI publications.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 289 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 22316

21603 **1987 international conference on coal science.** Moulijn, J.A.; Nater, K.A.; Chermin, H.A.G. (eds.). Amsterdam, The Netherlands; Elsevier Science Publishers B.V. (1989). 969p. Elsevier Science Publishing Co., Inc., 52 Vanderbilt Ave., New York, NY 10017. Order Number TI89007363/JAW. Contract FG01-87FE61071.

From International conference on coal science; Maastricht, Netherlands (26 Oct 1987).

Research programs, presented at the conference on coal science, October 1987 are presented. Major topics were: coal structure and characterization; coal liquefaction; beneficiation; coal gasification; pyrolysis; basic coal science; coal combustion; and other related topics. Individual projects under the above topics are processed separately for the data bases. (CBS)

0103 Preparation

REFER ALSO TO CITATION(S) 21603, 21628, 21637, 21650, 22315, 23206

21604 **(DOE/PC/79866—T4) Proof-of-concept testing of the HLC technology: Quarterly report.** (Process Technology, Inc., Calumet, MI (USA)). Feb 1989. Contract AC22-87PC79866. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009050/JAW.

The majority of the work conducted this quarter was part of the Installation and Shakedown task series (Task Series 400) as the final construction, process installation and circuit commissioning took place. The HLC circuit was shaken down with a coal/water slurry to ensure that the plant would operate as anticipated before methylene chloride was introduced. It was possible to calibrate most of the instruments using the coal/water slurry, so only minor modifications were necessary to adjust for the differences between water and methylene chloride. The equipment operated as expected during the commissioning with water except for some problems with the bead mill plugging up. When methylene chloride was put into the circuit, shakedown of the solvent recovery system began. Problems with the filter press and the secondary recovery system were encountered. The diaphragms on the filter are not holding up as well as they should; this is being investigated in conjunction with Larox. The regeneration cycles for the carbon columns in the secondary solvent recovery system are exceeding the loading cycles. One step being taken to alleviate this problem is reducing the methylene chloride draw from the plant by decreasing the vacuum pull. 3 tabs.

21605 **(DOE/PC/90536—T6) Autogenous process for low-ash and low-sulfur coal production: Final report.** Hu, Weibai; Rajamani, K. (Utah Univ., Salt Lake City (USA). Dept. of Metallurgy and Metallurgical Engineering). 30 Sep 1988. Contract FG22-86PC90536. 38p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006020/JAW.

The novel feature of the autogenous-carrier flotation process (ACF) is the use of coarse coal concentrate as a reagentized carrier for ultrafine coal; in other words, it takes self-generated reagentized fine particles as carrier for ultrafines. Special techniques have been developed to condition the carrier particles, such as using the normal coal-flotation reagents to condition and float the fine coal; then, whole or part of the froth is introduced into the ultrafine coal stream. Since the reagentized fine coal froth (carrier) carries over to the ultrafine coal (carried), reagent consumption is reduced, and moreover the selectivity and separation efficiency is increased. This investigation is the first of its kind where the autogenous-carrier flotation process has been tested for cleaning of US coals. The parameters of the ACF process have been studied. Simulation of the continuous process has been tested. The mechanisms of this process have been discussed. 11 refs., 23 figs., 8 tabs.

21606 **(DOE/PETC/TR—89/4) Interlaboratory comparison of advanced froth flotation processes.** Killmeyer, R.P.; Hucko, R.E.; Jacobsen, P.S. (USDOE Pittsburgh Energy Technology Center, PA). Mar 1989. 29p. (CONF-890238—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008897/JAW.

From Annual meeting and exhibit of the Society of Mining Engineers, Inc.; Las Vegas, NV, USA (27 Feb 1989).

In 1988, the Department of Energy's Pittsburgh Energy Technology Center completed five interlaboratory test programs aimed at comparing emerging advanced physical coal cleaning technologies. These five programs included heavy liquid separation, dry separation, selective agglomeration, novel froth flotation cell design, and new froth flotation reagents. Representative portions of three different bituminous coals were sent to all participating organizations; the coals were ground to the appropriate size for the particular process and beneficiated; and the clean coal and refuse products were returned to PETC for chemical analysis. The goal of the beneficiation process was to achieve as high a Btu recovery as possible with a clean coal ash content of 2%–3%. This paper will present the results of all of the participants involved in the two programs dealing with froth flotation. 3 refs., 4 figs., 8 tabs.

21607 **(NEDOJ—8808) Report of the survey on the foreign coal acceptance bases in FY 1987. Toward expanded demands of intermediate and small users.** (Japan Economic Research Inst. (Japan)). Mar 1988. 170p. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756854/JAW.

Problems in the coal conversion of intermediate and small users and measures to be taken for them are investigated. New technologies in coal utilization includes the fluidized bed boiler, coal cartridge system (CCS) and high concentration coal slurry (CWM). About 20 boilers with fluidized bed have been put in operation, mainly the bubbling type. They are reliable in operation and maintenance; their pollution control (desulfurization, denitrification) is effective, and the economic feasibility is established. Demonstration test of CCS has been completed in September 1987 with affirmed feasibility. Medium and small CWM boilers are under demonstration tests. The most important condition for coal conversion is the economic advantage according to the hearings. The difference between oil and coal prices is about 2 Yen/1000kcal. The acceptance bases are expected to be sufficient in quantity and required to have processing functions such as CCS, CWM, ash removal, ash processing and coal mixing in addition to the storage function. (33 figs, 36 tabs)

21608 **Sonic enhancement of the physical cleaning of coal.** Buttermore, W.H.; Slomka, B.J.; Dawson, M.R. (Ames Lab., Iowa State Univ., Ames, IA (US)). pp v of Proceedings of the fifth annual international Pittsburgh coal conference. Pittsburgh, PA; University of Pittsburgh (1988). (CONF-880915—).

From 5. annual international Pittsburgh coal conference; Pittsburgh, PA, USA (12 Sep 1988).

To evaluate the use of sonic energy for the enhancement of physical coal cleaning, brief sonication times, dense solids loadings, and a broad range of audible frequencies have been investigated as potentially economical means of improving the quantity and quality

of coal recovered from gravity-and surface-controlled cleaning processes. Results of numerous coal cleaning experiments with Illinois coal indicate that the yield and quality of coal product can be significantly improved by exposing a 30% (by Wt.) aqueous suspension of coal to sonication prior to separation by conventional means. Under certain conditions, the recovery of coal has been increased by sonication as much as 20 percent compared to coal cleaned without sonication. In other tests, ash content in the coal product has been reduced as much as 10% (from 10% down to 9%) compared to coal cleaned in an identical manner but without sonication. A sonic frequency of 4.0 kHz was found to be most effective for improving the separation of a finer (minus 100 mesh US) size fraction for the same coal using Denver cell flotation. In other tests, it was determined that sonic intensities below (rather than above) the threshold of cavitation are more effective in improving gravity-controlled coal cleaning processes.

0104 Processing

REFER ALSO TO CITATION(S) 21603, 21603, 21640, 21650, 21650, 21732, 21734, 21893, 21894, 22825

21609 **(BNL—42199) Mild gasification of coal in a moving bed reactor.** Sundaram, M.S.; Fallon, P.T.; Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). Nov 1988. Contract AC02-76CH00016. 9p. (CONF-890401—6). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008181/JAW.

From 197. national meeting of the American Chemical Society; Dallas, TX, USA (9 Apr 1989).

The Brookhaven National Laboratory (BNL) tubular moving-bed reactor was used to perform gasification experiments with Wellmore Kentucky No. 8 bituminous coal under mild reaction conditions at two levels of the process variables: temperatures of 550{degree} and 650{degree}C, coal particles residence times of 0.1 min. and 2 min.; and lime addition of 0% and 10% of the coal fed, with inert N_2 as the sweep gas. Using a fractional factorial statistical design, the interactive effects of process variables were evaluated. The highest total hydrocarbon yield of 22.6% (MAF) was obtained at 650{degree}C and 2 min. coal residence time in the presence of 10% lime additive. The gaseous hydrocarbon yield added only another 0.8% to the total hydrocarbon yield under the above conditions. The effect of coal residence time on total hydrocarbon yield was significant only at the higher temperature level of 650{degree}C and in the presence of the lime additive. 3 refs., 7 figs., 2 tabs.

21610 **(CRIE-W—87026) Estimation of cleaning intervals of porous ceramic filter in hot coal gas cleaning.** Ito, Shigeo; Watanabe, Masatoshi; Makino, Hisao; Nagayama, Tsutomu; Tanaka, Takashi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Mar 1988. 39p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756839/JAW.

On the development of a porous ceramic filter in a dust collector in the coal gasification combined cycle power generation, quantitative characteristics of pressure loss have been studied. The increasing rate of pressure loss during filtration is proportional to the dust (coal char) concentration and to the 2.6 power of the filtration rate. It is also proportional to 2nd power of the specific surface area if the area is relatively small. As a result a experimental formula to predict the pressure loss incresing rate was obtained. According to the test result in a hot gas clean-up unit with capacity of 2t/d, the existence of optimum char concentration zone was found to extend the cleaning interval of the filter. Because the specific surface area has a tendency to increase the value contrary to the decrease of the char concentration due to increasing micro char particle ratio, which causes the acceleration of the pressure loss increase. Lowering of the filtration rate enables the extension of the cleaning interval easily. However, it is necessary to enlarge the filtration area which makes the equipment larger. Therefore, it is necessary to consider the whole dust removal process. Using the experimental formula for the pressure loss, the allowable pressure loss, the cleaning interval and the filtration are obrained, then required dust collecting area is designed. (32 figs, 2 tabs, 3 refs)

21611 **(CRIE-W—87032) Collection efficiency of counter flow type electrostatic granular bed filter (2).** Makino, Hisao; Nagayama, Tsutomu, Watanabe, Masatoshi; Ito, Shigeo; Tanaka, Takashi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Apr 1988. 31p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756843/JAW.

A counter flow type electrostatic granular bed filter was developed for the dry type dust collector of coal gasification combined cycle. The main factors which have an influence on the collection performance were studied. In the experiments on the collection performance, the chars samples were prepared after one hour drying at 105°C. The designated applied voltage was set up after adjustment of filtration velocity. The collection efficiency shows best performance when the applied voltage reached the critical value of the breakdown voltage. For the moving velocity of bed particles, the optimum value that the collection efficiency is the best, is existance about the influx char volume. The lower the inlet concentration and the filtration velocity are, the lower the outlet char concentration is. It is possible that the filter outlet concentration is less than $10mg/m^3N$ under the conditions that filtration velocity is 20cm/sec and filter inlet char concentration is $5g/m^3$. (17 figs, 2 tabs, 11 refs)

21612 **(CRIE-W—87033) Long term reliability of desulfurization sorbent for hot coal gas desulfurization. Study on the characteristics of regeneration temperature (1).** Shirai, Yuzo; Nakayama, Mineo; Kobayashi, Makoto; Akiyoshi, Hisashi; Tanaka, Takashi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Apr 1988. 39p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756844/JAW.

In order to make clear the relevance between regeneration condition and regeneration temperature of desulfurization sorbent in a desulfurization-dry process at a coal gasification combined-cycle power plant, a dynamic simulation program was prepared, and the temperature characteristics in various regeneration conditions in a reactor were investigated. In the honeycomb fixed bed desulfurization process, it is required to keep the regeneration temperature under sorbent sintering temperature (800°C) during regeneration step. The desulfurization characteristics on a hot clean up unit with the capacity of 2 t/d are simulated through the program. The chemical conditions of iron component before regeneration are composed of three zones in the fixed bed; such as Fe_3O_4 zone at the gas inlet, FeS zone at the outlet, and Fe_3O_4 and FeS mixed boundary zone. Maximum regeneration temperature is found in the mixed boundary zone, and it is affected by the regeneration conditions such as the inlet gas temperature, the gas flow rate, O_2 concentration and the averaged sulfide ratio. It is possible to keep the regeneration temperature under the sintering temperature according to above mentioned four factors, and appropriate regeneration condition can be estimated. (17 figs, 3 tabs, 14 refs)

21613 **(DOE/CS/15068—T1) Coal gasification experiments: Final report.** (DuPont Aerospace Co., Inc., Torrance, CA (USA)). 31 Mar 1988. Contract FG01-81CS15068. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006703/JAW.

This report is the final report on the Externally Heated Entrained Gasification Experiment. The two major issues to be resolved by the testing were the ability to obtain a uniform heated wall temperature using flue gas obtained from the combustion of fuel gas and air and the degree of carbon conversion attainable in a gasifier using heated walls. The primary issue is the wall heating because prior experiments have demonstrated carbon conversion at the design gas temperatures. Results are discussed. 7 figs.

21614 **(DOE/ER/21423—1) The gasification of coal-peat and coal-wood chip mixtures in the University of Minnesota, two-stage coal gasifier: Final report.** Lewis, R.P. (Minnesota Univ., Minneapolis (USA). Physical Plant Maintenance and Operations). Dec 1986. Contract AS05-84ER21423. 45p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009143/JAW.

The technical feasibility of gasifying coal-peat and coal-wood chip mixtures with the University of Minnesota, Duluth Campus commercially technology two-stage coal gasifier was demonstrated during a series of experimental tests. Three types of processed peat products were mixed with coal and gasified. The three peat products were: peat briquettes, peat pellets and sod peat. The best peat product for gasification and handling was found to be peat pellets with a diameter of 7/8 inch and a length of .75 to 2 inches. A mixture of 65% coal and 35% peat pellets was found to cause no loss in gasifier efficiency and no operational problems. However, there was found to be no economic advantage in using coal-peat mixtures. The very limited testing performed with coal-wood chip mixtures indicated that the wood chips would be difficult to handle with the coal handling-equipment and there would be no economic advantage in using wood chips. 3 refs., 4 figs., 6 tabs.

21615 **(DOE/FE—0120) Underground coal gasification program plan, FY 1988.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of the Deputy Assistant Secretary for Oil, Gas, Shale and Special Technologies). Jun 1988. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008947/JAW.

Brief background information and program management plans research needs and strategy for underground coal gasification research is described. (CBS)

21616 **(DOE/METC—88/0262) Coal gasification: Technology status report.** Ghate, M.; Longanbach, J. (eds.). (USDOE Morgantown Energy Technology Center, WV). Jan 1988. 86p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE88010264/JAW.

The US Department of Energy's (DOE) Morgantown Energy Technology Center (METC) is sponsoring research and development (R and D) activities in surface coal gasification that are aimed at expanding the scientific and engineering database of coal gasification technology. The objective of the Surface Coal Gasification Program is to incorporate coal gasification in the systems that are being developed to meet several technical needs. Fundamental studies are being conducted on fluidized and entrained beds, the chemistry of ash components, catalysts for gas upgrading, methods for gas separations, and the chemistry of coal devolatilization and char gasification. Also underway are large-scale fixed-, fluidized-, and entrained-bed gasification studies that are integrated with studies of in-bed sulfur capture and external hot gas cleanup. Research is being done on environmental topics, as well as on components, materials, and instrumentation to support the development of all gasification technologies. Mathematical simulation of coal gasification is being developed to improve predictive capabilities and to conduct preliminary evaluations of various systems. This report describes the objectives, status, and accomplishments of the projects in the Surface Coal Gasification Program for FY 1987. 10 refs., 28 figs., 2 tabs.

21617 **(DOE/PC/79863—T8) Removal of chlorine from Illinois coal by high-temperature leaching: Final report, March 1--December 31, 1987.** Chen, Han Lin. (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). Mar 1988. Contract FC22-87PC79863. 22p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008377/JAW.

The objectives of this research are to: (1) conduct experimental investigations of the removal of chlorine from coal by high-temperature leaching; (2) identify important factors affecting the chlorine removal process; (3) understand the mechanisms involved; and (4) develop a mathematical model to describe the process. A generalized mathematical model based on diffusion and relaxation has been developed for water leaching of chlorine from coal. The model has been fitted to four different samples of Illinois No. 6 coal: C22175, C22651, C8601, and C8602. The weight percent of chlorine ranged from 0.42 to 0.82. The experimental data on these samples covered a temperature range of 297 to 370K and a particle size range of 60 to 325 mesh. Based on the type of coal and the conditions of leaching, it was found that 40 to 80% of the original chlorine could be leached from the coal matrix. The model based on diffusion-relaxation concept predicted the leaching data within +-5% average absolute deviation. The diffusion rate constants at different temperatures were correlated to Arrhenius type relations. Attempts made to correlate the constants in the Arrhenius equations with the chlorine content in coal and with particle size have been discussed. The water leaching data were used to extract Fickian diffusivities based on the time required for 50% desorption. The calculated diffusivity values ranged from 0.6 to 3 {times} 10/sup {minus}11/ cm^2/sec. The effect of chemical additives on the rate of leaching has also been studied. Both HNO_3 and NH_4OH were used as additives. 28 refs., 3 figs., 7 tabs.

21618 **(DOE/PC/79863—T18) Mechanism of extraction and desulfurization of coals with alcohols: Final report, March 1--December 31, 1987.** Muchmore, C.B.; Kent, A.C.; Smith, G.V.; Hinckley, C.C.; Phillips, J. (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). Mar 1988. Contract FC22-87PC79863. 38p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008367/JAW.

Eleven Illinois coals were used in desulfurization studies involving ethanol and methanol. Eight of these coals were subjected to supercritical methanol conditions both without and with pretreatment with KOH. The percentage sulfur removed by supercritical methanol treatment is largest for the lowest rank coal (lignite) and is progressively less as the rank increases until it is smallest for the highest rank coal (low-volatile bituminous). Prior treatment with KOH/MeOH usually improves sulfur removal during subsequent supercritical methanol treatment. Also, three Illinois coals were subjected to mixtures of ethanol or methanol and radical initiators. The presence of O_2, NO, or N_2O improves desulfurization with both ethanol and methanol. Finally, experiments designed to examine why pyrite reduces faster within the coal matrix than without compared the effects of different mixtures and sequential arrangements of pyrite and graphite during ethanol reduction of pyrite. Graphite increase the rate of pyrite reduction when it is intimately mixed with pyrite or precedes pyrite in a flow reactor. The results show that ethanol or methanol treatments of coals greatly reduce total sulfur (both pyritic and organic) by forming principally hydrogen sulfide. One mechanism of organic sulfur removal is to cycle it through the reduced iron sulfides within the coal matrix before reduction to hydrogen sulfide. Supercritical and radical-inducing conditions enhance sulfur removal and demonstrate that a variety of conditions can facilitate alcohol desulfurization of coals. Alcohols furnish hydrogen within the coal matrix either by iron sulfide (pyrrhotite or troilite) catalyzed decomposition or by radical-induced decomposition through interaction with radical initiators and/or with internal radicals generated by heating the coal matrix. 5 refs., 14 figs., 4 tabs.

21619 **(DOE/PC/80502—T13) Interactive chemistry of coal-petroleum processing: Quarterly report, December 15, 1988--March 15, 1989.** Curtis, C.W.; Guin, J.A.; Tarrer, A.R. (Auburn Univ., AL (USA). Dept. of Chemical Engineering). 1989. Contract FG22-85PC80502. 63p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009567/JAW.

The effect of the indigenous residuum metals on the interactive chemistry of coal-residuum coprocessing has been examined to some extent in this report. The two primary metals present in residuum are Ni and V. This quarterly report focuses upon the reactions occurring in the presence of Ni. The catalytic activity of Ni has been evaluated in the presence of individual and combined reaction systems. The catalytic hydrogenation of indan, indene, o-cresol, benzofuran, indole, quinoline and naphthalene in a mixture is described. 13 refs., 7 figs., 6 tabs. (CBS)

21620 **(DOE/PC/88861—T10) Mechanistic study of chlorine removal from coal by high-temperature leaching: Final report, January 1--December 31, 1988.** Chen, H.L.; Muchmore, C.B. (Southern Illinois Univ., Carbondale (USA)). Mar 1989. Contract FC22-88PC88861. 23p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009577/JAW.

Experiments were performed to measure the effect of several key process factors on the rate of chlorine removal by hot water

leaching and to increase our understanding of the mechanisms involved. Experimental results on leachability of five coal samples having similar initial chlorine contents (0.40 to 0.46%) have indicated significant differences in chlorine removal under identical experimental conditions. It is postulated that the differences are attributed to effective pore volume and/or the chlorine distribution in the coal structure. Two experimental procedures were developed to measure the moisture content of coal at different particle sizes and chlorine distribution in the coal structure. This additional information will permit evaluation of the effect of these factors on kinetic parameters of a mathematical model that has been proposed. 14 refs., 8 figs., 2 tabs.

21621 **(EPRI-GS—6283) Baltimore gas and electric company's study of a shell-based GCC power plant: Final report.** Bourquin, R.H. Jr.; Hattrup, J.B.; Kusterer, J.N.; Crumley, T.E. Jr.; Marshall, J.E. (Electric Power Research Inst., Palo Alto, CA (USA); Baltimore Gas and Electric Co., MD (USA)). Mar 1989. 288p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report presents the results of a study conducted by the Baltimore Gas and Electric Company (BG and E) to develop and evaluate performance, cost and economic information for a nominal 400 MWe, phased, Shell-based gasification-combined-cycle (GCC) power located at BG and E's Perryman site. Phases 1 and 2 consist of two identical distillate-fired GE MS7001F advanced combustion turbines each producing a nominal 140 MWe. In Phase 3 a steam bottoming cycle is added, increasing the plant output to about 420 MWe, and in Phase 4 a coal gasification facility is added. The study results indicate that a 90{degree}F, the Phase 4 GCC power plant has a heat rate on coal of 9100 Btu/kWh and a total capital requirement of $1585/kW. Total capital requirements for the initial phases ranged from approximately $450/kW for the simple cycle plant to $530/kW for the combined cycle facility. A sensitivity study which investigated the use of alternate coals showed only modest cost and performance impacts for designing the gasification plant to handle several coals having a fairly broad range of properties. The performance and cost information was used by BG and E to perform an economic assessment consisting of production costs, revenue requirements, and other financial results. This assessment indicated that: (1) for all scenarios, the GCC option was better than a pulverized coal alternative; (2) the combustion turbine and combined-cycle options, essentially equal economically, were generally preferred over the GCC for differential cost escalations between coal and distillate of approximately 2.0% or less; (3) for higher differential distillate-to-coal cost escalations, the GCC had lower total revenue requirements than either the combustion turbine or combined cycle option; and (4) BG and E should continue to monitor coal gasification development, and periodically review the fuel cost projections and potential economic benefits of phased GCC power plants. 41 figs., 54 tabs.

21622 **(LT—8709) Mathematical modelling of coprocessing kinetics.** Szladow, A.J.; Chan, R.K.; Tscheng, J. (Lobbe Technologies Ltd., Regina, Saskatchewan (Canada)). 1987. 258p. (MICROLOG—88-05008). Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, ON, Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report presents the results and conclusions of a study whose objectives included a review of previously generated coprocessing data with a view to identify and quantify the effects of process variables on the rates of generation and selectivities of coal/heavy oil or bitumen coprocessing products; to formulate and test kinetic models for coprocessing reactions; and to predict the yield structure and product distribution for coprocessing. A review of the literature on coal liquefaction and heavy oil upgrading was also undertaken. Analysis of the effects of temperature and space velocity on product yield and selectivity showed the product yield structure to be determined primarily by the severity of the process, i.e. by temperature and the extent of thermal cracking. Understanding coprocessing reactions was greatly aided by multiple classification analysis, which depicted the temperature/space velocity effects mentioned above, and which also explained the difficulties in modelling preasphaltenes. Coprocessing models were formulated based on the multiple classification analysis reaction paths. A number of reaction networks were evaluated for two types of models. The best model, a parallel type model which incorporated some sequential characteristics, explained 90% of total variance. Testing of the derived kinetics model for sensitivity to the assumptions made showed that models' predictive capabilities did not change with the selection of different gas hold-ups and fraction of feed flashed at the reactor temperature and pressure. This report also contains a computer program listing for an IBM PC/XT for solving the kinetic parameters for coprocessing. 65 refs., 35 figs., 29 tabs.

21623 **(NEDOJ-P—8706) Investigation on improvement of coal liquefaction technologies and its economic effect.** (Fuel Society of Japan, Tokyo). Mar 1988. 153p. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756479/JAW.

On pretreatment of coal for liquefaction, superior technologies have been investigated in a view point of process efficiency and economy. The first industrial-scale application of steam drying unit has been constructed in South Africa in 1985. The unit dries 2000 kg/h of activated carbon pellets from an initial moisture content of 50% down to 2%. The installed cost of the unit is about 40% less than a conventional air dryer of the same capacity. In case of the organic reduction method by anionization of coal with alkali metal, hydrogenation to aromatics and dissociation of C-C, C-O bonding have been confirmed. The liquefaction conversion rate of 29.5% of untreated coal was increased 47 to 56 % by use of the organic reduction method. On the other hand, the properties and new utilization of alternative fuel, such as coal liquid, shale oil and others were investigated. Furthermore, the study was focused on the situation of process development and the product properties from the co-processing process and the comparison of the process with the direct coal liquefaction process. The product from this process has higher H/C ratio than that of coal liquid. (42 figs, 73 tabs, 208 refs)

21624 **(NEDOJ-P—8707) Feasibility studies on application possibility of petroleum refining technologies to the coal liquefaction (3).** (New Energy and Industrial Technology Development Organization, Tokyo (Japan)). May 1988. 165p. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756480/JAW.

As a result of reviewing the mechanism of formation sludges in petroleum fuel oils containing heavy fractions, it was found that sludge formation is started principally through the reduction of solubility of heavy aromatic compoents induced by oxidation and cracking, and the dissolving activity of the matrix components is reduced by structural modification and dilution. The components decreasing the compatibility of blended fuels with coal liquids was investigated. Stability of coal liquids was improved when asphaltenes and polar asphaltenes were removed by distillation. In order to establish the technology to prevent the deterioration of the catalyst activity, it is desirable for the successful development of a process to effectively decrease alkali metal or alkaline earth metal compounds. Fundamental studies revealed that catalysts proposed for NEDOL pilot plant CGS (from molten iron gasifier) contain metallic iron and wuestite dust-sulfur and synthetic pyrite are superior to conventional red-mud sulfur catalyst. (107 figs, 65 tabs, 163 refs)

21625 **(ORNL—6522) Fossil Energy Program semiannual progress report, April 1988--September 1988.** Judkins, R.R. (Oak Ridge National Lab., TN (USA)). Jan 1989. Contract AC05-84OR21400. 185p. NTIS, PC A09/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008975/JAW.

This report covers progress made during the period April 1 through September 30, 1988, for research and development projects that contribute to the advancement of various fossil energy technologies. Projects on the Fossil Energy Program are supported by DOE Office of Fossil Energy, DOE Office of Basic Energy Sciences, and the Tennessee Valley Authority. Included are programs in: materials research, environmental analysis and information systems, coal conversion, upgrading condensibles from coal devolatilization, mild gasification, supply models, fluidized bed combustion,

support to the Strategic Petroleum Reserve, coal characterization, and basic coal chemistry. 105 refs., 54 figs., 36 tabs.

21626 (ORNL/TM—10793) Development of iron aluminides for coal conversion systems. McKamey, C.G.; Liu, C.T.; David, S.A.; Horton, J.A.; Pierce, D.H.; Campbell, J.J. (Oak Ridge National Lab., TN (USA)). Jul 1988. Contract AC05-84OR21400. 61p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008966/JAW.

A study is under way to develop iron aluminide alloys based on Fe_3Al with an optimum combination of strength, ductility, and corrosion resistance for use as hot components in advanced fossil energy conversion systems. The study to date has included two phases: (1) properties of Fe-Al-based compositions between 24 and 30% Al were studied and an evaluation made of their potential for further alloy development; and (2) one binary alloy was chosen for further alloy development and property characterization. Studies include fabricability, microstructure, tensile properties, oxidation and sulfidation resistance, and weldability. The report summarizes the results of the two phases of work described above. A discussions of the effect of aluminum concentration on mechanical properties of the binary alloys prepared in phase 1 of this study is included. From the results of phase 1, it was determined that Fe-28 at. % Al is the most promising alloy for further development. Initially, 0.5 wt % TiB_2 ({approximately}1 at. %) was added for grain refinement. It has since been determined that not only are the TiB_2 precipitates deleterious to the weldability, but that grain refinement can be produced by the addition of other elements. Therefore, the addition of TiB_2 was halted after the initial studies of the effects of ternary additions. In phase 2, additions of chromium, niobium, boron, and molybdenum were shown to improve high-temperature strength, room-temperature ductility, and creep resistance. The results of weldability, tensile, and creep tests, as well as the present status of oxidation and corrosion studies, are reported. 42 refs., 29 figs., 6 tabs.

21627 (ST—8507) Application of Centrax separation process to liquid products from ten different coprocessing slurry samples. Final report. (Sandwell Technologies (Canada)). 1985. 108p. (MICROLOG—88-03129). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The Centrax process is a general process for deashing of hydrocarbon mixtures, using a process-derived extractant to extract the liquid products and centrifugal action to separate the liquid and solid phases. Experiments were conducted to investigate the performance of the process on slurry product samples from CANMET coprocessing. Physical and chemical properties of the samples were characterized, and preliminary separations/extractions were performed to investigate the effect of separation temperature, amount of extractant and type of extractant on ash removal and liquid product recoveries. A suitable process configuration was then developed, and material balance flow diagrams were constructed. It was found that total liquid recovery by the Centrax process is in the 95-100% range. Ash concentrate did not contain tetrahydrofuran-soluble materials and had good friability. Separated solids cake was very difficult to handle, due to its viscous, sticky, and plastic nature, but successive extractant additions to the cake dramatically changed it to an incompressible, abrasive material. Extensive difficulties were encountered in processing the samples due to their nonhomogeneity as exhibited by significant asphaltene and pre-asphaltene precipitation. Specific findings on process parameters included the following. Asphaltene and pre-asphaltene recoveries of 69-95% were achieved by using a non-optimized 4-stage countercurrent process configuration. Ash concentrations as low as 0-0.03% can be achieved in the liquid product. During the flash evaporation stage, gas production can be reduced to zero, and little or no asphaltenes and pre-asphaltenes are recovered. 1 ref., 23 figs., 46 tabs.

21628 Recovery and regeneration of caustic for use in cleaning of coal by the molten caustic leaching process. Chriswell, C.D.; Shah, N.D.; Markuszewski, R. (Ames Lab., USDOE, Iowa State Univ., Ames, IA (US)). pp v of Proceedings of the fifth annual international Pittsburgh coal conference. Pittsburgh, PA; University of Pittsburgh (1988). (CONF-880915—).

From 5. annual international Pittsburgh coal conference; Pittsburgh, PA, USA (12 Sep 1988).

The molten caustic leaching (MCL) process is an advanced chemical coal cleaning process, being developed by TRW, which leads to removal of over 90% of the ash-forming mineral matter and up to 90% of the sulfur from physically precleaned coal samples. In the MCL process, coal is first leached with molten caustic, and the resulting coal-caustic cake is washed in sequence with water, dilute acid, and water again. The spent caustic solutions arising from the water-washing step contain unreacted caustic, salts of mineral species leached from the coal, sulfides, carbonates, humic acids, and phenols. The recovery of unreacted caustic and the regeneration of spent caustic from the alkali metal slats are important factors in the overall feasibility of the MCL process. During the past five years, work at the AMES Laboratory on the MCL process has included developing an understanding of reactions occurring during the leaching step, evaluating procedures for recovering unreacted caustic, regenerating caustic from alkali metal salts formed during the MCL process, and suppressing side reactions that lead to the formation of carbonates and humic acids and result in the excessive consumption of caustic. In this paper, reaction pathways leading to the removal of sulfur-containing moities and ash-forming minerals and to the formation of humates and carbonates during molten caustic leaching are reviewed, results of studies on a proposed countercurrent water-washing procedure for the recovery of unreacted caustic are summarized, and procedures for the regeneration of caustic from reaction products are discussed.

0106 Properties

REFER ALSO TO CITATION(S) 21603, 21606, 21625, 21655, 21663, 21664, 21666, 22695

21629 (CONF-8809248—9) The Indonesian coal program until the year 2000. Johannas. (East-West Center, Honolulu, HI (USA). Resource Systems Inst.). 1988. 42p. OSTI - East-West Center, Resource Systems Institute, 1777 East-West Road, Honolulu, HI 96822. Order Number TI89008130/JAW.

From Coal trade workshop: the dynamics of expanding supply; Honolulu, HI, USA (30 Sep 1988).

The coal industry of Indonesia is discussed with reference to the history of coal use, exports and imports, as well as forecasting to the year 2000. Coal production and coal quality are also addressed. Numerical data for the above topics are included. 1 fig., 23 tabs. (CBS)

21630 (DOE/ER/13268—T1) The geochemistry of coal origins in relation to coal structure: Final technical report. Given, P.H.; Spackman, W.; Painter, P.C. (Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences). 6 Oct 1987. Contract FG02-84ER13268. 4p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009092/JAW.

The principal objective of the study is to seek an understanding of the processes involved in the transformation of ligno-cellulosic cell walls of higher plants into coal-forming entities during the early stages of coal formation. It is felt that this is one valid and potentially valuable approach to solving the problems of coal structure and elucidating the origins of coal macerals. The tactical approach has been to select samples of very immature coals that exhibit differing degrees of preservation of woody structure and examine them by optical microscopy, using transmission of light through thin sections with and without polarizing screens, and fluorescence excited by blue or uv light. Specimens characterized in this way were then studied by Fourier Transform Infrared spectroscopy, ^{13}C NMR and various pyrolysis/mass spectrometric techniques. Samples from two different sites were available, but most of

the work was on a large set of samples collected from the Brandon lignite in Vermont; plants whose remains are seen in this lignite include many of those now populating parts of the Okefenokee Swamp in Georgia and the Everglades of Florida. A number of samples of peatified wood were included in the microscopic studies, in order to document the earliest changes and provide material for comparison.

21631 **(DOE/PC/79863—T7) Microcrystalline iron sulfide particles in coal: A Moessbauer study: Final report, March 1--December 31, 1987.** Hinckley, C.C.; Smith, G.V.; Saporoschenko, M. (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). Mar 1988. Contract FC22-87PC79863. 67p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008398/JAW.

Organic sulfur can be removed from coal using a process which employs iron sulfides as in-situ catalysts. The active desulfurization catalyst is troilite, or a pyrrohtite/troilite mixture. In this project Moessbauer spectroscopy was used to study acid washed desulfurized chars. Moessbauer spectra of a specially prepared group of pyrrhotite standards were also analyzed. Parameter values obtained for these samples are reported and related to the iron sulfide composition. Moessbauer spectra of washed chars exhibit doublets which may be partly attributed to microcrystalline pyrite present in the coal before treatment. Spectra of these materials have been analyzed with the help of Fourier smoothing techniques and a standard iterative method to fit Lorentzian functions to Moessbauer spectra. A sample of microcrystalline iron oxide was used as a standard to test analysis procedures. Analyses of selected low temperature char spectra confirm the presence of super-paramagnetic particles, but also indicate that they are predominantly iron oxides. Particles exhibiting internal magnetic field values characteristic of pyrrhotites are present in the samples in low concentrations. Approximately half of the spectra observed in the chars is due to non-magnetic iron compounds. 12 refs., 7 figs.

21632 **(DOE/PC/79863—T9) Mixing of sulfur between pyritic and organic phases during coal conversion processes: Annual report, March 1--December 31, 1987.** Dunkerton, L.V.; Mehrotra, S.; Mitra, S.; Phillips, J.B.; Hackley, K.C. (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). Mar 1988. Contract FC22-87PC79863. 21p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008376/JAW.

The mixing of sulfur between the inorganic phase and the organic phase of coal may influence the extent of total sulfur removal during coal conversion processes. This project is designed to determine the extent of such mixing. Continuing studies on the use of substituted dibenzothiophenes to monitor mixing of sulfur between pyritic and organic phases has primarily focused on using labeled sulfur compounds to monitor the migration from organic compounds to the iron sulfide. To distinguish migration of more easily desulfurized types from thiophenic sulfur, ^{34}S labeled compounds were prepared from dibenzothiophene with a ^{34}S labeled easily desulfurized group attached. The hydrodesulfurization with and without troilite in a model coal environment is being studied. This experiment required that isotope ratio analysis techniques be adapted to monitoring the ratio of $H_2{}^{32}S$ to $H_2{}^{34}S$ during hydrodesulfurization as well as analyzing the isotope ratio of the solid residues. Quadrupole mass spectrometer detection was carried out and the results compared to those obtained from multiplex gas chromatography detection. Both techniques showed thiomethyl group desulfurization occurring between 523K and 600K while the thiophenic group slowly began to desulfurize around 725K. The synthesis of labeled dibenzothiophene from 2,2' biphenyl and ^{34}S was achieved in 54% yield, and this method is also applicable to preparation of ^{33}S labeled dibenzothiophene for a ^{33}S NMR enriched sample. The synthesis of ^{34}S labeled dibenzothiophene from 2,2'dinitrobiphenyl has progressed through the preparation of 2-aminobiphenyl-2'-thiol in which the label was introduced from ^{34}S thiourea. 23 refs., 4 figs.

21633 **(DOE/PC/79863—T10) Coal-ash agglomeration during combustion and/or gasification: Final report, March 1--December 31, 1987.** O'Brien, W.S. (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). Mar 1988. Contract FC22-87PC79863. 16p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008375/JAW.

This project seeks to develop a procedure to identify the lowest temperature at which particles of coal ash begin to stick together. This test will consist of oxidizing the coal under precisely controlled conditions, then heating the sized coal-ash particles to progressively higher temperatures until the particle size distribution significantly increases, indicating the onset of agglomeration. The agglomeration temperatures of several different coals will be then compared with their respective chemical and physical characteristics, including their ASTM-measured ash fusibility properties. The project work during most of the project period involved preparatory tasks awaiting the arrival of the programmable ashing furnace. The furnace was installed in mid-September and startup tests were conducted to evaluate its performance capabilities. However, problems in accurately controlling the temperature inside the oven chamber delayed the actual start of the specific project experimental studies until November. The initial task, which is currently underway involves preparing stock supplies of the ashes of three coals from the Illinois Coal Basin. The auxiliary equipment and analytical procedures have been readied to demonstrate the measurement of the agglomeration temperatures of these coal ashes. Although the formal time period for this project has ended, the research study activity will continue into Calendar Year 1988, in order to complete the stated project objectives. After the formal test for determining the agglomerating temperature has been demonstrated and the sensitivity effects of its operating procedure parameters have been evaluated, the developed test procedure will be performed on the several Illinois basin coals. 14 refs.

21634 **(DOE/PC/79863—T13) Spontaneous combustion of coal and maceral enriched fractions under storage pneumatic transport conditions: Final report, March 1--December 31, 1987.** Malhotra, V.M.; Crelling, J.C. (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). Mar 1988. Contract FC22-87PC79863. 97p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008372/JAW.

The objective of this project is to understand the mechanisms responsible for the spontaneous combustion of ultrafine (particle size < 250 μm) bituminous coals and of maceral-enriched fractions under storage, air flow, and/or dense-phase pneumatic transport conditions. Specifically, this research attempts to understand physical interactions and chemical reaction pathways, which may lead to spontaneous ignition of bituminous coals, by examining the role played by maceral type and concentration, by water wetting, by particle size, by volatile content, by moisture content, and by ash content on the low temperature oxidation susceptibility and ignition characteristics of bituminous coals. To determine the role of these factors, spontaneous ignition temperature measurements, low temperature oxidation measurements via Fourier transform infrared (FTIR) analyses, and differential scanning calorimetry measurements were made on eight bituminous coals from the Hartshorne seam, on Elkhorn No. 3 high-volatile bituminous coal, and on pure maceral fractions of bituminous coal. 27 refs., 62 figs., 7 tabs.

21635 **(DOE/PC/79863—T14) Interactionn of sulfur-containing compounds with transition metal clusters and metal surfaces: Final report, March 1--December 31, 1987.** Tyrrell, J.; Combariza, J.; Dunkerton, L.V.; Pandey, A. (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). Mar 1988. Contract FC22-87PC79863. 48p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008371/JAW.

Molecular orbital calculations on the nickel pentamer cluster were carried out using ab initio methods as well as density functional methods. The molecular orbital cluster approach using effective core potentials (ECP) was used for the ab initio calculations and the Xa statistical approach for the density functional method.

The results are strongly dependent on the particular procedure used to obtain the electronic ground state of the cluster. The packing of the molecular orbitals begins to resemble some of the characteristics of the band structure of bulk metals. The spectra for nickel pentamer can be considered as being formed by a dense band of doubly occupied d-orbitals and small band containing those orbitals with s character and singly occupied d-orbitals. The electronic configuration on each nickel atom can be approximated as $3d^9$, $4s^1$ but participation of 4p orbitals in the chemical bonding increases with the size of the cluster. Interactions of small molecules (CO and NO) with transition metal clusters are being simulated and the nature of the chemical bonding between the substrate and the absorbate is being studied. A series of transition metal complexes incorporating 4-substituted dibenzothiophenes as monodentate and bidentate ligands have been prepared and the types of sulfur ligand binding compared.

21636 **(DOE/PC/79863—T16) Vanadium speciation in Illinois coal: Final report, March 1--December 31, 1987.** Koropchak, J.A. (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). Mar 1988. Contract FC22-87PC79863. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008369/JAW.

A method for the study of trace element speciation in coal, based on the efficient room temperature dissolution of the coal with DMSO, was investigated. Coal dissolution efficiency, trace element extraction, and mass balance are reported. Size exclusion chromatography with element selective detection by ICP-AES was used for the study of the resultant solutions. Preliminary investigations of Chelex extraction to remove dissolved cations are discussed. Prospects for wider applicability of these procedures, based on improved ICP-AES detection, are described. 26 refs., 3 figs., 7 tabs.

21637 **(DOE/PC/88912—T1) Roles of additives and surface control in slurry atomization: Quarterly report.** Tsai, S.C. (California State Univ., Long Beach (USA)). Jan 1989. Contract FG22-88PC88912. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009096/JAW.

This research project is concerned with basic studies of coal water slurry (CWS) atomization and deep coal cleaning for use in CWS with emphasis on coal surface characterization and modification. A bench scale unit for slurry atomization and a Malvern Zeta Sizer for surface characterization have been established. A Denver laboratory flotation cell has also been purchased. Brief descriptions of the atomization setup and the atomizer design are given below followed by an outline of immediate future plans. 2 figs., 1 tab.

21638 **(DOE/PC/90502—10) Catalyst accessibility in high volatile bituminous coal: Quarterly report.** Kispert, L.D. (Alabama Univ., University (USA). Dept. of Chemistry). Apr 1989. Contract FG22-86PC90502. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009543/JAW.

As reported previously (DOE/PC/90502-1 to 9) we are making use of an EPR technique developed in this lab to determine the pore size and number distribution in high volatile bituminous coal using nitroxide spin probes I-IX of different sizes, shapes, and reactivity. New and very interesting conclusions about the accessible pore volume for a given spin probe upon swelling with a given solvent were obtained from swelling experiments this quarter. Previously published work has suggested that highly crosslinked macromolecular network of coals will swell in contact with organic solvents to an extent which depends on the chemical nature of the organic solvent. Pyridine has been found to be a good swelling solvent capable of breaking a significant percentage of the hydrogen bonds in coals. It is reasonable that the amount of swelling is greater for the coals with higher oxygen content because the potential for hydrogen bonding is greater. For the studied APCS, the oxygen content (moisture and ash free (MAF) values vary from 20.34% (Beulah-Zap) to 2.47% (Pocahontas)). The swelling experiment was performed for APCS with pyridine as the swelling solvent using cylindrical or spherical spin probes. The results for pyridine and toluene are compared. A very good linear correlation was found for the concentration of the cylindrical and spherical spin probes versus the percent oxygen content. 3 figs., 3 tabs.

21639 **(DOE/PC/90521—T9) Role of porosity in supercritical fluid extraction of coal: Technical progress report.** Bale, H.D. (North Dakota Univ., Grand Forks (USA)). 15 Mar 1989. Contract FG22-86PC90521. 11p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009047/JAW.

In our previous report we presented scattering results which helped to establish the important role of the micropore structure in fluid extraction of coal. We were able to demonstrate that the in situ small angle scattering technique is a powerful method of examining the characteristics of micropore filling by the extracting fluid. Work has continued along much the same direction, utilizing in situ small angle scattering measurements on Wyodak subbituminous coal during extraction with tetrahydrofuron (THF). We have also completed our analysis of the scattering curves in terms of the pore model which is very helpful in making our description of micropore filling and micropore dilation more qualitative. Results are discussed for micropore dilation at 380{degree}C, micropore behavior at 120{degree}C and coal treatment with methanol at 120{degree}C. 3 figs., 1 tab.

21640 **Experimental and theoretical investigation of the formation and growth of ash agglomerates.** Carty, R.H.; Mason, D.M.; Kline, S.; Babu, S.P. (Institute of Gas Technology, 3424 South State Street, Chicago, IL (US)). pp 828-839 of Proceedings of the fifth annual international Pittsburgh coal conference. Pittsburgh, PA; University of Pittsburgh (1988). (CONF-880915—).

From 5. annual international Pittsburgh coal conference; Pittsburgh, PA, USA (12 Sep 1988).

The behavior of coal mineral matter is of concern in ash-agglomerating gasifiers because it governs deposition on gasifier internals and down-stream surfaces as well as ash removal. The ultimate aim of the IGT research program in ash chemistry is to be able to predict quantitatively the behavior of the mineral matter in a fluidized-bed gasifier based on the operating conditions of the gasifier and a minimum analysis of the characteristics of the mineral matter present in the coal feed. The current program combines experimental studies and a theoretical analysis to accomplish this objective. In this paper, the reaction of the coal mineral matter with limestone used as a sulfur-capture agent is discussed.

21641 **Fluid mechanics and thermal behavior of coal slag layers on CDIF coal-fired MHD generator walls.** Lohrasbi, J. (MSE, Inc., Butte, MT (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889375.

The flow and heat transfer of a two-phase slag layer on the walls of a coal-fired magnetohydrodynamic (MHD) generator were analyzed using a slag layer model. The model consisted of a slag flowing over a frozen slag layer having non-newtonian behavior. The model was assumed to be steady, one dimensional, viscous, and electrically conducting. Experimental data collected in the 50 MW/sub t/ MHD generator at the Component Development and Integratin Facility (CDIF) in Butte, Montana, were used for fluid mechanics and thermal behavior calculations of the coal slag layer model. This study is expected to be useful in understanding the effect of the presence of slag layers on the heat transfer characteristics for the two coal types used in the CDIF coal-fired MHD generator. For the temperature range present in the MHD generator, the slag layer transport properties were expected to be strong functions of temperature. In this study, the viscosity and electrical conductivity of the slag varied widely depending on the temperature. Therefore, the governing equations were nonlinear, coupled, and solved numerically. An iterative scheme was developed for these equations, and the results were presented for a wide range of parameters.

21642 Alumina recovery from fly ash by the lime-soda sinter process. Burnet, G. (Ames Lab., US Dept. of Energy and Iowa State Univ., Ames, IA (US)). pp 10.1 of Proceedings of the international symposium on ash. Pretoria, South Africa; Council for Scientific and Technical Research (1987). (CONF-870257—Absts.).

From Symposium on ash: a new resource; Pretoria, South Africa (2 Feb 1987).

Fly ash contains minerals as both major and minor constituents and is capable of becoming a valuable resource. Alumina is the principle mineral of interest and a lime-soda sinter process for its recovery has been developed at the Ames Laboratory. The process has been fully researched and its feasibility demonstrated through mini-pilot plant scale investigation. In the process, fly ash is combined with limestone and soda ash as a mineralizer, formed into pellets, and sintered. During sintering at 1200° to 1300°C, soluble calcium and/or sodium aluminates and insoluble calcium silicate compounds are formed. The sintered pellets are then leached with dilute soda ash solution to dissolve the aluminate compounds in high yield. Aluminum trihydroxide is recovered from the leaching extract by pH reduction through sparging with CO/sub 2/. Calcination of the precipitate yields metallurgical grade alumina. Other wastes such as flue gas desulfurization sludge and cement kiln dust can be used as calcium sources for the process. The process residue is primarily dicalcium silicate and shows promise as a raw material for the manufacture of conventional and low-alumina portland cement. The economics of a combined alumina recovery and cement production facility are promising.

0108 Waste Management

REFER ALSO TO CITATION(S) 21607, 21642, 21649, 21650, 21664, 21690, 21717, 21975, 21976, 21977, 21980, 22315, 22330, 22333, 22418, 23066

21643 (DOE/METC—89/0263) Gas stream cleanup: Technology status report. Williams, M.C. (ed.); Bedick, R.C. (ed.). (USDOE Morgantown Energy Technology Center, WV). Oct 1988. 46p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000925/JAW.

The objective of the Gas Stream Cleanup (GSC) Program is to develop contaminant control technology to separate out, or otherwise control, contaminants from the hot exhaust or fuel gases. The program's activity is mainly aimed at separating out contaminants at pressures greater than 5 atm and temperatures greater than 1,000{degree}F. These elevated pressures and temperatures are associated with seven emerging systems: pressurized fluidized-bed combustion (PFBC), integrated gasification combined-cycle (IGCC), gasification/molten-carbonate fuel-cell (MCFC), gasification/solid-oxide fuel-cell (SOFC), direct coal-fueled turbine (DCFT), coal-fueled diesel (CFD), and mild gasification (MG). The activities of GSC can be conveniently organized under the systems in which the contaminant control technology has been or plans to be implemented. Many of the activities are cross-cutting, since some systems have similar operating conditions, temperatures and pressures, and similar gas compositions. This makes GSC technology transferable from system to system. This Technology Status Report discusses each GSC activity in most detail under the system in which its development has proceeded most quickly. The potential for cross-cutting technology transfer is pointed out where appropriate. 20 refs., 21 figs., 5 tabs.

21644 (DOE/PC/88873—T2) Global approach for enhanced mass transfer effects in-duct flue gas desulfurization processes: Quarterly technical progress report No. 2. (Energy and Environmental Research Corp., Irvine, CA (USA)). 18 Jan 1989. Contract AC22-88PC88873. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009054/JAW.

Efforts have focused on the initiation of experimental studies and preliminary work on the development of a model of the duct injection process. Initial experimental studies are to be conducted in a single slurry droplet reactor operating in a dilute modes so that slurry droplets do not interact. A feasibility study was conducted to evaluate the performance of a monosized droplet generator originally proposed for this application. The droplet generator was not capable of meeting the range of conditions required in the reactor experiment. A modified rotary-disk atomizer was evaluated as the most appropriate. The performance of the atomizer has been characterized over the anticipated range of operation, to verify its ability to meet the requirements of the experimental program. Shakedown testing and quality assurance checks of the experiment and sampling systems have also been conducted. An existing version of EER's one-dimensional slurry model has been adapted to a more user-friendly format and delivered to DOE. This first generation code provides a framework for the development of an advanced induct SO_2 capture model. 7 figs.

21645 (NEDOJ—8807) Report on the investigation for the preparation of material (Part 2). On the trends in coal utilization technology and its international cooperation. (Coal Mining Research Centre (Japan)). Mar 1988. 170p. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756853/JAW.

The levels of coal utilization and production technology in Japan are investigated and evaluated. Of the coal utilization technology, the ordinary pressure bubbling fluidized bed combustion is in the stage of proliferation, and the ordinary pressure circulation fluidized bed combustion is on the introduction base. The pressurized fluidized bed combustion technology is under R and D in Japan and under pilot plant study in the U.S, U.K. and Sweden. The coal-water slurry is being put in practice. Coal-ash utilization is established in the cement, aggregates, construction and building materials, agriculture and fishery. Of the coal production technology, boring is in the introduction base, and the coal production is at the equal level to U.S and Europe. The mechanization of excavation is under development. Technology of transportation Japan is comparable with the world for both face and mine drift transportation. The safety technology in diversified mine environments of Japan is gathering attention from foreign countries. (1 fig, 12 tabs, 16 refs.)

21646 Emission studies of full-scale cofiring of pelletized RDF/coal at Argonne National Laboratory. Daugherty, K.; Ohlsson, O.O.; Venables, B. (N. Texas State Univ., Denton, TX (US); Argonne Nat. Lab., Argonne, IL (US); TRAC Labs., Inc., Denton, TX (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889442.

In FY 1984, Argonne National Laboratory (ANL) issued a competitively solicited research contract to North Texas State University (NTSU) to conduct a multi-phase research study to examine the use of low-cost binders for producing improved densified refuse-derived fuel (dRDF) pellets. The laboratory test phase of this study was completed in FY 1984 and the pilot plant phase in FY 1985. The results of these tests indicated that lime (calcium hydroxide) was the top-ranked binding agent. As the third and final phase of the multi-phase study, ANL/NTSU conducted full-scale cofired combustion tests of binder-enhanced dRDF pellets and high-sulfur coal. These tests were conducted during June and July of 1987 in ANL's Boiler #5, which is a spreader-stoker boiler. These tests were conducted with industry, state, and municipality participation both in critiquing the test plan and in witnessing the actual test runs. Approximately 600 tons of dRDF containing 0%, 4%, or 8% binder were blended with high-sulfur coal at levels of up to 30%, based on the Btu content. This paper describes the dRDF/coal cofiring test, the emission and ash samples that were taken, the analyses which were conducted on these samples, preliminary test results, and future research plans.

21647 Aspects of disposal, environmental impact and resource recovery from coal combustion solid wastes. Burnet, G. (Ames Lab., US Dept. of Energy and Iowa State Univ., Ames, IA (US)). pp B.2 of Proceedings of the international symposium on ash. Pretoria, South Africa; Council for Scientific and Technical Research (1987). (CONF-870257—Absts.).

From Symposium on ash: a new resource; Pretoria, South Africa (2 Feb 1987).

This paper examines the principal technical and economic issues affecting the disposal and utilization of solid wastes arising from coal use between now and the end of the century. Requirements at coal-fired power plants for more efficient particulate control facilities and new flue gas desulfurization facilities have increased the cost of managing the waste materials by adding to the quantity of material to be managed and altering its chemical and physical make-up. While solid residues from coal use are not generally seen as a major national problem, they may have significant impact at a local level. An important future consideration is the utilization of wastes resulting from new energy technologies and having different characteristics. Technologies included are fluidized bed combustion, flue gas dry scrubbers, and special multistage combustion burners. These developments would lead to replacement of pulverized coal fly ash with new ash forms which contain highly reactive materials such as alkaline oxides and sulfites. The key resource recovery issues are seen as the variability inherent in the composition of the solid residues, uncertainty over the scale and location of their production, uncertainty over possible changes in the legislative/regulatory environment and uncertainty over the economically beneficial utilization of the wastes. Worldwide research on utilization has advanced to the stage where problem definition is clear and some processes are ready for development. The future calls for a longer term, more comprehensive approach and work on new waste forms.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 21607, 21611, 21612, 21625, 23063

21648 **(CRIE—W-02) Properties and emmission control of sub-micron particles in pulverized coal combustion.** Makino, Hisao; Nagayama, Tsutomu; Sato, Mikio; Watanabe, Masatoshi; Ito, Shigeo. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). May 1987. 85p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757163/JAW.

The properties and emission control of sub-micron particles in pulverized coal combustion were investigated. Various measurement methods of sub-micron particle size distribution such as electrical aerosal size analyzer, laser dust monitor, differential mobility analyzer combined with condensation nucleus counter, low pressure cascade impactor and andersen stack sampler, showed correct results in measuring performances in all methods. The low boiling point elements, for example As, Cd, Se are vaporized at the furnace and condensed to the particle surface. As the specific surface of sub-micron particle is high, the As, Cd, Se concentrations in submicron particles become very high. The collection efficiency of Bag-filter and Electrostatic granular Bed Filter with Precharger for sub-micron particles is higher than that of Electrostatic Precipitator. If the pulverized coal and combustion air are mixed well in the primary combustion area near the burners, it is possible that the formation of sub-micron particles is reduced. (71 figs, 20 tabs, 24 refs)

21649 **(CRIEPI-EU—88003) Migration of trace elements leached from coal ash in soil - lysimeter experiments simulating the landfilling disposal site.** Shimogaki, H.; Igarashi, T. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Dec 1988. 51p. Central Research Institute of Electric Power Industry, Tokyo, Japan.

The Central Research Institute of Electric Power Industry (CRIEPI) is currently developing a method for predicting the effect of landfilling disposal of coal ash on soil and inland-water environment. This method involves the modelling of a phenomenon in which chromium, boron, arsenic and other harmful trace elements leach from a coal ash landfilling disposal site covered up with soil owing to the infiltration of rainwater and migrate into the environment. When constructing this model, however, a laboratory specimen test alone is not enough, but it is additionally necessary to quantitatively determine the leaching of trace elements and their migration velocity in the ground under actual landfilling conditions. Because of this, experiments were conducted under rainfall conditions close to the actual environment by constructing a simulated landfilling site to determine these points in detail and at the same time, a landfilling technique to be applied in the future was also discussed. 3 refs., 42 figs., 5 tabs.

21650 **(DOE/PEIA—0002) Innovative Clean Coal Technology: Programmatic Environmental Impact Analysis (PEIA).** (USDOE Assistant Secretary for Fossil Energy, Washington, DC). Sep 1988. 254p. NTIS, PC A12/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008582/JAW.

This Programmatic Environmental Impact Analysis (PEIA) has been prepared by the US Department of Energy (DOE) to support the proposed action of selection for cost-shared federal funding of one or more innovative clean coal projects proposed by the private sector in response to the Innovative Clean Coal Technology (ICCT) Program solicitation. The PEIA contains a description of generic technologies which are representative of the specific proposals received. From these generic technologies, forecasts are developed which describe the environmental impacts resulting from widespread deployment of commercial scale facilities. In addition, a separate appendix (Appendix C) contains performance factors relating to the specific proposals. The analysis contained in this appendix is not available to the public since it contains business confidential and proprietary information. A second part of the NEPA strategy involves the preparation of the preselection project-specific environmental review report prepared by the ICCT Source Evaluation Board (SEB). This environmental review report is also unavailable to the public. However, the Source Selection Official will consider the PEIA (including the confidential Appendix C), along with the preselection project-specific environmental reviews, as part of the selection process. The third element of the NEPA strategy will be the preparation of site-specific NEPA documentation for each ICCT demonstration project selected to receive financial assistance. These site-specific documents will be available to the public. 199 refs., 39 figs., 43 tabs.

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 21629, 21645, 21675, 21697

21651 **(NEDOJ—8803) Investigation of the promotion of foundation construction of foreign coal import bases in FY 1987. Report on the investigation of coal of the the Central and South America.** (Engineering Advancement Association of Japan (Japan)). Mar 1988. 182p. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88756849/JAW.

The report describes results of investigation on the coal of China conducted in 1987. Estimation and established abundance are 2 trillion tons and 740 billion tons, respectively, of which 59% is in the Northern China and 19% in the Northwest region. The primary energy consumption is 800 million tons equivalent to coal, of which coal is about 80%. About 3/4 of coal is consumed for production and construction, e.g., thermal power generation, coke production and railway transportation, with the remaining 1/4 for household use. Use of coal gas is being promoted for household consumption from the viewpoint of efficiency and pollution control. Coal is used as fuel or raw material in the chemical industry, e.g., synthetic ammonia, carbide acetylene and methanol. The National Planning Committee has established a basic policy on coal and is promoting the development with foreign funds and technology. Export is also encouraged. The production costs are 40-48 Yuan per ton in North China and 65-88 Yuan per ton in Northeast and Mid-China regions. The price of North China coal has strong competing power. The export is increasing and the target for 1990 is 30 million tons. (53 figs, 74 tabs, 27 refs.)

21652 **(NEDOJ—8804) Investigation of the promotion of foundation construction of foreign coal import bases in 1987. Report on the investigation of coal of Central and South America.** (Japan Coal Development Co. Ltd., Tokyo). Mar 1988. 107p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756850/JAW.

The report describes results of survey on the coal of Central and South Americas in 1987. Total import of raw material coal in the Central and South America was 11 million tons with Brazil as the largest importer. About 35 million tons of coal was consumed. The coal trade is still negligible with small amounts of coal produced by tiny firms for domestic consumption. Large development has been planned, however, after the oil crisis for utilization of do-

mestic resources and increased income of foreign currencies. Production has been initiated at Selehon Nose Mine in Colombia and Guasare Mine in Venezuela. The former sets the target of annual outputs at 15 million tons and the latter at 6,500,000 tons, both of them being planned for export. While their main market is Western Europe, expansion of markets in U.S and Far East is also intended. About 35 million tons will be exported to world markets in mid-1990's, including coals from newly exploited mines. Its impact to Japan cannot be overlooked. No concrete measures are established for possible increase of import of Colombian coal to U.S. (15 figs, 43 tabs, 12 refs.)

21653 **(NEDOJ—8806) Report of the survey on 'trends and overview of coal exploration technology'.** (Coal Mining Research Centre (Japan)). Mar 1988. 193p. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88756852/JAW.

This survey is aimed at describing the present status of coal exploration technology and to forecast the direction of its development in forthcoming years. The survey covers the determination of stratigraphic sequence and geological history based on geological investigations, estimation of sedimentary environments, estimation of changes in the area and thickness of coal layers that complements the physical exploration, and determination of stratum level for exploration. The investigation of stratigraphic sequence requires determination of geological ages by paleobios and measurement of absolute ages of ignitions rocks. Comparison of coal layers is possible by paleobiological investigation such as the heavy mineral analysis and pollen analysis, X-ray analysis of clay minerals, measurement of reflection rate of vitrinite. the fluorescence analysis of sporinite and the maceral analysis of coal. The physical exploration methods include the gravity and magnetic exploration, and reflection seismometric method; the former is rough exploration method and the latter is fine. The position of subject and the method can be pinpointed by establishing the coal field sedimentation model. (140 figs, 29 tabs, 36 refs)

21654 **(NP—9770293) Explosion-proof TV system for logging seams and adjacent strata as well as tectonic surfaces in underground boreholes. Final report.** Wagener, B.; Brenken, W. (Bergbau-Forschung G.m.b.H. Forschungsinstitut des Steinkohlenbergbauvereins, Essen (Germany, F.R.); Ruhrkohle A.G., Essen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Apr 1986. 63p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89770293/JAW.

A technology for logging boreholes of up to 600 m of depth had to be developed. The task was successfully accomplished by a construction of a 60-mm-probe. While the probe scans the lower borehole section, the drill string remains in the higher borehole section to serve as protective tubing. Initial reliability trouble could be eliminated by dimensional minimizing of components and by a vibration-damped transport casing to a far-going extent. In all cases the protective automatic turned out to be fully reliable. Other fields of use: Spotting of deformations, leaks, incrustations and other damages in pipelines. In shaft sinking, surveys of freezing boreholes yielded further knowledge on the stresses acting on freezing boreholes. When, over limited periods, the allowable environment temperature (+10 to +45/sup 0/C) was exceeded satisfactory performance and results were still recorded at temperatures of +92/sup 0/C and -24/sup 0/C. For logging of large-diameter (up to 1400 mm) boreholes, a new axially fitted head was provided. With diameters of up to 3000 mm still satisfactoring recordings were made, however, this is the upper performance limit in the low-contrast carboniferous. (orig.) With 27 figs., 7 tabs., 12 refs.

21655 **(SECV—50-83-70) Coal quality zones in Yallourn open cut. Part 1: first cross-section.** Brockway, D.J.; Hibbert, W.D.; George, A.M.; Attwood, D.H.; Kiss, L.T. (State Electricity Commission of Victoria, Melbourne (Australia). Research and Development Dept.). Dec 1983. vp. State Electricity Commission of Victoria, Melbourne (Australia). Research and Development Dept.

The first stage of a detailed examination of the properties of the coal at the operating faces of the Yallourn Open Cut in the Latrobe Valley, Victoria, Australia is reported. Three fully cored bores were drilled and samples were taken at approximately 0.3 m intervals. These were analysed for selected proerties related to energy and fouling. Six defined lithotype layer zones have been identified in the cross-section and have been consolidated to four coal quality zones based on differences in chemical properties. Zone 1 (top of seam) is characterised by the lowest net wet specific energy and reasonably uniform coal. Zone 2 has unusual properties; it is mostly high gross dry specific energy coal with a relatively low content of volatile matter. Zone 3 has the most variable coal, although the average net wet specific energy is between the values in Zones 2 and 4. The lowest, Zone 4, has the highest net wet specific energy. The variability of inorganic ions is also mapped and there is a significant level of soluble aluminium in Zone 4. The highest ash levels are found in Zone 4 and the lowest in Zone 2. The coal with the highest sodium and lowest calcium content is found in Zone 1 and the coal with the lowest sodium and highest calcium content is found in Zone 4.

21656 **Volcanic and sedimentary origins remain distinctive in clay-rich horizons of Costa Rican lignites and peats.** Raymond, R. Jr.; Bish, D.L.; Archuleta, L.M.; Cohen, A.D. (Los Alamos National Laboratory, NM (USA)). *Geological Society of America, Abstracts with Programs;* **17**: 695(1985). (CONF-8510489—).

From 98. annual meeting of the Geological Society of America; Orlando, FL, USA (28 Oct 1985).

Tertiary lignite and Recent peat deposits in Costa Rica were sampled to determine the origin of associated clay-rich horizons using x-ray diffraction and x-ray fluorescence techniques. A lignite deposit near Zent contains two types of clay-rich horizons. One type comprises two 2-5 cm thick partings composed mostly of kaolin clay with minor amounts of quartz. Mean Al_2O_3 and SiO_2 contents of the partings are 44.54 and 50.08 wt%. The second type both discontinuously overlies one of the kaolin partings and continuously underlies the lignite seam. This second type of horizon contains smectite as well as kaolin clays, more quartz than the partings, and pyrite. Comparable clay-rich horizons are present in Costa Rican peat deposits. A 30 cm thick clay parting of known volcanic origin occurring within a peat deposit north of Siquirres is composed of halloysite and minor amounts of quartz, gibbsite, and crystobalite. A clay-rich horizon of fluvial origin that directly underlies a peat deposit southeast of Los Chiles is composed of smectite and kaolin clays, quartz, albite, and iron-bearing minerals. Similarities between the partings in the peat at Siquirres and in the lignite at Zent suggest a volcanic origin for the lignite partings. Other clay-rich lignite horizons appear to have a sedimentary origin, similar to the underlying clay-rich horizon at Los Chiles, rather than being deposited directly as volcanic ashfall. Thus it appears that volcanic ashfall-derived materials can be distinguished from sedimentary materials in Costa Rican lignites and peats based on differences in bulk mineralogical and chemical compositions.

0120 Mining

REFER ALSO TO CITATION(S) 21629, 21645, 21652, 21680, 21681, 21682, 21683, 21722, 23892

21657 **(EUR—11899-DE) Improved measurement and prediction in the monitoring of shaft-guide equipment with a view to preventing damage to conveyances and production stoppages.** Kirch; Schaefler. (Commission of the European Communities, Luxembourg). 1988. 78p. (In German). Commission of the European Communities, Luxembourg.

The equipment currently used for shaft-guide measurement by scanning rollers transfers the measured values to a plotter via Bowden cables. The research project sought to replace these with inductive path sensors in the form of electrical signals on magnetic tape, the recorded values being displayed in analog/digital mode. The appropriate values (deviation of track width and deviation of guide width of both columns from the reference values) are transferred from the magnetic tape and printed out on an analog plotter. For surveying the shaft-guide column for verticality and straightness appropriate modifications were made to the ISSM (inertial shaft measuring system). The system operates by calculating the gauge and rotation of the cage from the inertial measuring unit,

while shaft-guide verticality and straightness are calculated via polar fixing of the measured distances between guides. Orthogonally-disposed accelerometers are used to measure cage acceleration and travel path. During the course of the project measurement accuracy was improved by several orders of magnitude (verticality error <5 cm/1000 m; reproducibility <2 cm/1000 m; travel path measurement <0.5 m/1000 m). Preliminary tests using a contact less scanning system for measuring the track gauge and flank widths have proved promising.

21658 **(ICTIS-M—0206) Exploration of lignite deposits and homogenization possibilities of the raw coal.** Fidorra, U.; Stoll, R.D. (IEA Coal Research, London (UK)). Apr 1987. 135p. IEA Coal Research, London (United Kingdom).

In microfiche form.

This report covers the following: evaluation of lignite deposits; determining mining methods with special reference to the demand for a qualitatively consistent rate of production; influences of extraction on the quality requirements of run-of-mine coal; stockyard engineering; example of unions within vast lignite deposits with variations of coal quality; and the Rhenish mining area.

21659 **(NP—9770291) Systematic improvement - follow-up: Developement of means for work on systematic improvement in underground coal mining. Final report.** Baethmann, H.J.; Korf, P.; Mayer, K.; Schaefer, T.H.W. (Ruhrkohle A.G., Essen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1988. 298p. (In German). NTIS (US Sales Only), PC A13/MF A01. Order Number DE89770291/JAW.

The superordinate project task was specified to be extension and improvement of previously developed EDP-based means for planning, monitoring and improvement of operations underground. Thus, the reporting system 'RUBIS' for operations monitoring and control was newly developed on the basis of the operation 'equipment and salvaging of coal faces', the network planning system 'PLUS.EINS' for methods engineering was further developed and adapted to underground requirements, and the planning method 'Bergmaennische Zeitplanung' (mine operations planning) was complemented by a programme component for movement of face equipment from one face to the other which gave encouraging test results. For planning and optimization of road heading systems by simulation technology the algorithm of the existing computer model 'Sprengvortrieb' was improved, and the computer model 'Teilschnittmaschinenvortrieb' (road heading by point attack machines) was newly developed to the laboratory phase. For improving time study work the 'DEGIS'-method was further developed for being run in personal computers, a work studies data bank was set up within the RAG-internal colliery project data file (ZPD), the concept of a programme system for equipment studies was set up, and new efficient data gathering and processing systems were tested. (orig./MOS) With 75 figs., 109 refs.

21660 **(NP—9770292) Reduction of mineral fall risks in roadheading and coalface repairs. Final report.** Schmidt, F.W.; Ketterer, K. (Ruhrkohle A.G., Essen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Apr 1986. 48p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770292/JAW.

A high number of accidents caused by mineral fall is the reason for R and D work in view of new coalface and roadway support techniques. Three targets was aimed at: Prevention of mineral fall, strata consolidation, and filling of cavities caused by mineral fall. The following methods were developed: Snug fit of roadway support to strata by mortar filled hoses and cushions. Use of air bags and plastic foam filled cushions, partially with lost filling mechanisms. Consolidation of exposed fissured strata surfaces by quick setting immediately bearing mortars sprayed onto said surfaces. Filling of mineral fall cavities with foam concrete. These developments were successful in several areas.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 21607, 21634, 21645, 21884

0140 Combustion

REFER ALSO TO CITATION(S) 21603, 21625, 21634, 21647, 21648, 21650, 22315

21661 **(CONF-890377—1) Simulation and modeling of atmospheric fluidized bed combustors for high sulfur coals.** Krishnan, R.P.; Daw, C.S.; Byrd, J.; Wells, J.W. (Oak Ridge National Lab., TN (USA)). [1989]. Contract AC05-84OR21400. 18p. NTIS, PC A03 - OSTI. Order Number DE89008567/JAW.

From International seminar on mathematical modeling of processes in energy systems; Sarajevo, Yugoslavia (20 Mar 1989).

This paper briefly summarizes the state-of-the-art in Atmospheric Fluidized Bed Combustion (AFBC) modeling and uses the Oak Ridge National Laboratory (ORNL)-Tennessee Valley Authority (TVA) AFBC steady-state model as an example to illustrate how some major modeling concerns have been addressed. Other recent models are briefly described and compared with the ORNL-TVA model. The reader is referred to the references cited for details on the assumptions and computational methods. 100 refs., 8 figs., 1 tab.

21662 **(CONF-890402—3) FBC [fluidized-bed combustors] engineering correlations for estimating the combustion efficiency of a range of fuels.** Daw, C.S.; Chandran, R.R.; Duqum, J.N.; Perna, M.A.; Petrill, E.M. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007842/JAW.

From 10. international conference on fluidized-bed combustion; San Francisco, CA, USA (30 Apr 1989).

Simplified engineering correlations are presented for estimating the combustion efficiency of a wide range of fuel types in fluidized bed boilers. The correlations are presented in such a way that they can be applied to various boiler designs, including both bubbling and circulating beds. Major emphasis is placed on minimizing the boiler design and operating details required, thereby enhancing the usefulness of these methods as screening tools. The impact of fuel type is addressed by making use of the fuel characterization parameters measured by the Babcock and Wilcox Company for the Electric Power Research Institute. It is demonstrated that the methods described give combustion efficiency estimates that agree well with typical observations from some well-documented fluidized bed combustion test facilities. 16 refs., 9 figs., 1 tab.

21663 **(CONF-890402—4) Performance testing with high ash Indian coals and coal washery rejects in an AFBC pilot plant.** Krishnan, R.P.; Anthony, J.; Rajavel, M.; Srinivasan, S.; Rao, A.J.; Rajaram, S. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007832/JAW.

From 10. international conference on fluidized-bed combustion; San Francisco, CA, USA (30 Apr 1989).

Under a cooperative agreement between the US Agency for International Development (USAID) and the Government of India (GOI), a joint research project in fluidized bed combustion (FBC) is being carried out by the Bharat Heavy Electricals Ltd. (BHEL), India, and the Oak Ridge National Laboratory (ORNL). The project is aimed at obtaining basic engineering data on the combustion of high-ash Indian coals (up to 45% ash), coal washery rejects (up to 70% ash), and high-sulfur (up to 5%) US coals. Quantitative measurements of freeboard combustion, freeboard heat transfer, and freeboard gas composition are of particular interest. A FBC test facility has been erected at BHEL, Trichy. Tests have been conducted on a sub-bituminous Indian coal (38% ash) and a washery reject (65% ash) with and without flyash reinjection. The combustion efficiency was typically 95-98% for the coal and 85-90% for the re-

jects. Freeboard combustion was 6-9% for the coal and 3-6% for the rejects. 11 refs., 6 figs., 2 tabs.

21664 **(CONF-8809162—) Advanced research and technology development (AR&TD) direct utilization and instrumentation & diagnostics contractors review meeting: Proceedings.** (USDOE Pittsburgh Energy Technology Center, PA; USDOE Morgantown Energy Technology Center, WV). 1988. 707p. NTIS, PC A99/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007029/JAW.

From Advanced Research and Technology Development (AR&TD) direct utilization, instrumentation, and diagnostics contractors review meeting; Pittsburgh, PA, USA (6 Sep 1988).

This annual meeting provides a forum for the exchange of information between DOE AR&TD contractors and interested parties and was attended by approximately 150 individuals from industry, academia, national laboratories, and other Governmental agencies. Papers were presented on research relating to coal properties, pyrolysis, combustion phenomena, gas cleanup, particulate removal, ash behavior, instrumentation, and coal-water-fuel utilization. A total of 10 technical sessions were chaired by staff from the Pittsburgh and Morgantown Energy Technology Centers. Because of the large number of ongoing projects, a poster session was included at this year's meeting in order to provide the opportunity for technical interchange between all AR&TD supported researchers. Papers describing these projects are also included in the proceedings. Individual projects are processed separately for the data bases.

21665 **(DOE/PC/30297—T11) Assessment of pulverized-coal-fired combustion performance: Final report for the period September 1980--September 1983.** Richter, W.F.; Clark, W.; Pohl, J.H.; Payne, R. (Energy and Environmental Research Corp., Irvine, CA (USA)). Jun 1987. Contract AC22-80PC30297. 347p. NTIS, PC A15/MF A01 - OSTI; 1; GPO Dep. Order Number TI89005560/JAW.

The purpose of this program was to evaluate an engineering analysis procedure which could be used to assess the impact on thermal performance of converting gas and oil fired equipment to coal. The program consisted of four major tasks: (1) Engineering Analysis. The objective was to evaluate currently available models which could be used to predict combustor performance and to define a procedure which could be used to assess the impact of a coal firing in a boiler or furnace; (2) Reactor Studies. The purpose was to evaluate, under controlled conditions, the radiative properties of fly ash clouds; (3) Pilot Scale Experiments. This involved a combustion trial with gas and coals which were burned at 0.7 {times} 10^6 Btu/hr in a pilot-scale combustor. The purpose was to verify and supplement the results of the small-scale reactor studies on the radiant properties of coal flames at larger scale; (4) Reporting. Engineering analysis procedures were used to identify those fuels related properties which had a major impact on the thermal performance of furnaces. The major result of the study is that thermal performance of coal-fired furnaces is dominated by the formation of fly ash deposits on the heat transfer surfaces. The key parameters which influence thermal performance are: thickness, thermal conductivity, and surface emissivity or absorptivity. 105 refs., 170 figs., 29 tabs.

21666 **(DOE/PC/79863—T15) Reactivity of coals and selected pure maceral fractions: Final report, March 1--December 31, 1987.** Crelling, J.C.; Hippo, E.J. (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). Mar 1988. Contract FC22-87PC79863. 43p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008370/JAW.

A primary purpose of coal science is to characterize a given coal sample well enough to predict its behavior in any process of interest, such as pyrolysis, gasification, liquefaction, or coking. Currently, chemical analysis and optical microscopy are used in defining predictive properties such as coal rank and type. However, the present predictive capability is somewhat imperfect due, in part, to the fact that most work has been carried out on heterogeneous samples. The overall objective of this project was to determine the process response properties of pure single coal maceral fractions in order to predict the behavior of various whole coals of different maceral compositions and rank. There are four general and equally important conclusions about the reactivity properties of coal that are supported by the results of this study: (1) Most of the reactivity and combustion profile parameters varied significantly with coal rank. (2) All of the rank trends observed were best defined in the data from the pure maceral samples. The data on the pure macerals were more reproducible, the relationships were more linear, and the range of variation with rank was smaller. (3) The variations in the combustion profiles and reactivities in different macerals from the same sample are of the same order of magnitude as the variations due to rank. (4) It appears that there are maceral interactions during combustion and gasification that significantly affect these processes. 14 refs., 2 figs., 5 tabs.

21667 **(DOE/PC/79863—T19) Fine particle coal as a source of energy in small-user applications: Final report, March 1--December 31, 1987.** Rajan, S.; Davis, P.K. (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). Apr 1988. Contract FC22-87PC79863. 49p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008379/JAW.

This report describes the progress made during the current contract period in the evaluation of the performance of a pulse combustor, in the size suitable for small-scale applications. Fuels tested include gaseous propane and a beneficiated micronized coal. Test show that both these fuels could be burned well in the pulse combustor, but the fuel-air mixture conditions for optimum performance for each fuel was different. Data is also presented for the NO/sub x/, SO_2, and unburned hydrocarbon emissions with the various fuels. Further tests with the coal fuels are continuing. In related studies, the influence of limestone addition on the rheology and stability of coal-water mixtures has been evaluated. 10 refs., 22 figs., 4 tabs.

21668 **(DOE/PC/88861—T7) Fine particle coal as a source of energy in small-user applications: Final report, January 1--December 31, 1988.** Rajan, S. (Southern Illinois Univ., Carbondale (USA). Dept. of Mechanical Engineering and Energy Processes). Mar 1989. Contract FC22-88PC88861. 34p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009574/JAW.

With the aim of developing an advanced design pulse combustor for small scale applications suitable for burning micronized coal and CWM fuels, a 150,000 Btu/hr pulsating combustion test rig has been fabricated and instrumented. The pulse combustor has been operated on beneficiated micronized coal without any auxiliary fuel. The effect of equivalence ratio on pulse combustor efficiency and emissions has been investigated and combustion efficiencies on the order of 94% have been measured. The influence of coal composition on the efficiency and emissions properties during pulsating combustion has been investigated. Results show that coal composition influences conversion efficiency. Sulfur dioxide emissions are strongly influenced by fuel-sulfur content, while NO/sub x/ emissions are influenced by both fuel nitrogen and coal combustion history under pulsating conditions. The 150,000 Btu/hr pulse combustor has also been operated with two different resonance tube lengths on two samples of beneficiated coal from the same Illinois seam, having identical elemental and proximate analyses. Results show that frequency controls mixing and residence time, which in turn influences combustor temperature profiles and perhaps combustion efficiency. However, the tests show that better mixing, lower temperatures, and shorter residence times at higher frequencies are conducive to producing lower oxides of nitrogen emissions. 10 refs., 15 figs., 3 tabs.

21669 **Recent developments in Tecogen's residential CWS-fired warm-air furnace system.** Batra, S.K.; Balsavich, J.C.; Becker, F.E.; Smolensky, L.A. (Tecogen Inc., Waltham, MA (US)). pp v of Proceedings of the fifth annual international Pittsburgh coal conference. Pittsburgh, PA; University of Pittsburgh (1988). (CONF-880915—).

From 5. annual international Pittsburgh coal conference; Pittsburgh, PA, USA (12 Sep 1988).

Under a contract with the U.S. Department of Energy, Pittsburgh Energy Technology Center (PETC), Tecogen Inc., is developing a CWS-fueled residential warm-air heating system. The overall objective of the research program is to develop an economically

viable, CWS-fired residential warm-air furnace competitive in size, performance, reliability and ease of operation with respect to present oil-and gas-fired systems. The intended system will be modular in design and suitable for use in both forced-air and hydronic systems. In order to have efficient combustion of CWS fuel in the residential furnace, Tecogen has evaluated various combustor concepts and has developed an innovative type of combustor, best described as an Inertial Reactor with Internal Separation (IRIS). The IRIS combustor makes use of centrifugal (cyclone) forces with one or more partitions to retard axial flow of unburned coal particles above a given size. This increases the residence time for combustion of CWS fuel. With this system, the carbon-conversion efficiency increases significantly without need for very fine or high-pressure atomization. The paper describes the program plan, design for the combustor, and significant features of Tecogen's CWS-fired warm-air furnace system. Recent developments and experimental results of combustion of CWS in a prototype combustor are also presented.

21670 **Advanced gas turbine 'proof-of-concept' program.** Horner, M.W. (General Electric Co., Aircraft Engines, 1 Neumann Way, Cincinnati, OH (US)). pp v of Proceedings of the fifth annual international Pittsburgh coal conference. Pittsburgh, PA; University of Pittsburgh (1988). (CONF-880915—).

From 5. annual international Pittsburgh coal conference; Pittsburgh, PA, USA (12 Sep 1988).

Significant successes have been achieved under the advanced gas turbine 'proof-of-concept' program. The technical challenges - fuel preparation, handling, storage and atomization, combustion, deposition, erosion, corrosion, gaseous and particulate emissions - have been addressed. In addition, commercial system economics have been considered, and economic projections show that, when successfully developed, acceptable rates of return can be attained with direct coal fired gas turbine systems. Potential technical barriers have been identified and innovative solutions for their resolution have been developed.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 21607, 21629, 21651, 21652, 22317, 22318

21671 **(CONF-8809248—2) Energy and coal supply and demand in Korea: Trends and outlook.** Ryu, Ji-Chul. (Korea Energy Economics Inst., Seoul (Republic of Korea)). 1988. 27p. NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE89008140/JAW.

From Coal trade workshop: the dynamics of expanding supply; Honolulu, HI, USA (30 Sep 1988).

This report reviews the general trends in energy consumption and energy demand in Korea. Coal supply and coal demand are emphasized. Detailed statistical data are included. 17 tabs. (TC)

21672 **(CONF-8809248—3) An economic analysis of coal demand in Taiwan.** Hsu, G.J.Y. (Chung-Hwa Institution for Economic Research, Taipei (Taiwan)). 1988. 21p. NTIS (US Sales Only), PC A03 - OSTI. Order Number DE89008137/JAW.

From Coal trade workshop: the dynamics of expanding supply; Honolulu, HI, USA (30 Sep 1988).

Coal consumption in Taiwan is discussed with regard to demand by various industrial sectors. (CBS)

21673 **(CONF-8809248—4) Coal trade model.** Kulp, J.; Wilson, T. (East-West Center, Honolulu, HI (USA). Resource Systems Inst.). 1988. 23p. OSTI - Resource Systems Institute, East-West Center, 1777 East-West Road, Honolulu, HI 96822. Order Number TI89008136/JAW.

From Coal trade workshop: the dynamics of expanding supply; Honolulu, HI, USA (30 Sep 1988).

The Coal Trade Model (CTM) has been developed by the Energy Program at the East-West Center. It was designed to analyze international trade in steam coal. Special emphasis is given to the Asia-Pacific region. CTM is based on databases of coal exporters and importers,with both the quantity and quality of coals produced or consumed included. CTM estimates international trade which would occur in a perfectly competitive market. The solution takes into account differences in coal quality and transportation cost. Some types of trade constraints can also be included. The model is implemented on a PC.

21674 **(CONF-8809248—5) A review of China's coal export potential through her domestic demand and supply.** Jia, Yunzhen. (Ministry of Coal Industry, Beijing (China)). 1988. 15p. NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE89008135/JAW.

From Coal trade workshop: the dynamics of expanding supply; Honolulu, HI, USA (30 Sep 1988).

To export coal to the world market is China's state policy. China will continue to further develop island transport systems and port facilities and, at the same time, to improve quality to improve its image. It is difficult to give exact figures showing how much coal will be exported in the coming years, since many factors govern production. However, China's share of the world coal market will increase. This report also emphasizes China's domestical supply and demand of coal, and presents energy consumption pattern in China. 2 tabs.

21675 **(CONF-8809248—6) China's coal industry: Prospects for investment.** Otto, J.M. (East-West Center, Honolulu, HI (USA)). 1988. 21p. OSTI - Resource Systems Inst., East-West Center, 1777 East-West Road, Honolulu, HI 96822. Order Number TI89008134/JAW.

From Coal trade workshop: the dynamics of expanding supply; Honolulu, HI, USA (30 Sep 1988).

If the People's Republic of China is to meet its goal of adding 500 million tonnes of annual coal capacity between 1986 and the year 2000, it will need to invest between 50 to 75 billion yuan. China lacks the ability to raise this amount internally and will need to seek foreign participation to meet its production targets. To put planned expansions in perspective, the author presents historical statistics on China's coal industry and discusses its plans for the future. In addition, the investment climate for various types of foreign cooperation is discussed. The author concludes that China is a difficult and risky country in which to do business and that patience and perseverance are necessary requirements for concluding a business arrangement. 17 refs., 4 tabs.

21676 **(CONF-8809248—8) Australian coal in 2000: It will meet the challenge.** Huleatt, M.B. (Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia)). 1988. 25p. NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE89008132/JAW.

From Coal trade workshop: the dynamics of expanding supply; Honolulu, HI, USA (30 Sep 1988).

The Australian black coal industry is based on substantial resources. Australian coals range in rank from sub-bituminous to semi-anthracite. Almost 98% of total resources are located in New South Wales and Queensland. Following a succession of record years raw and saleable coal production peaked in 1987 at 178.6 million tonnes (Mt) and 145 Mt respectively. At 44.7 Mt domestic consumption was also a record. With exports of 102 Mt Australia maintained its position as the world's leading exporter. Underlying the industry's performance is continually increasing productivity. In 1987 productivity in underground mines on an all employees basis was 14.4 tonnes per manshift (tms), and increase of 13% in two years. The equivalent productivity for open cut mines was 35.3 tms, a 10% increase in two yeas. Numerous predictions of Australia's exports in 2000 have been made. These will be considered in conjunction with Australia's projected domestic requirements. Current production capacity falls short of the projected year 2000 demand. Potential for increasing capacity to meet that demand is examined in both qualitative and quantitative terms. 17 tabs.

21677 **(CONF-8809248—10) The demand for coal: Taiwan's perspective.** Zheng, Chinlong. (Chung-Hwa Institution for Economic Research, Taipei (Taiwan)). 1988. 17p. NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE89008138/JAW.

From Coal trade workshop: the dynamics of expanding supply; Honolulu, HI, USA (30 Sep 1988).

Coal was the most important domestic energy resource in Taiwan in 1960s. The demand for coal, especially imported coal, is increasing as a result of recent deregulation of coal importation and the government's diversification policy on energy. The appreciation of local currency against US dollar and the rapid fall in energy price after 1986 will stimulate the demand of energy Taiwan. The delay of the construction of the fourth nuclear power plant and the planning of the first natural gas fired power reflect the changing trend of energy used in the electricity sector, the largest coal user, caused by recent environmental movements in Taiwan. This report tries to give a brief introduction on energy and coal demand in Taiwan. Section II and III depict the trend and its shifting forces. In section IV, a simple economic model for coal consumption is constructed, and then is applied to quantify the empirical relationship between the demand for coal and its explanatory variables, and a conclusion is presented in section V. 5 refs., 4 figs., 4 tabs.

21678 **(NEDOJ—8802) Report of the investigation on ASIAN coal producing countries.** (Institute of Energy Economics, Tokyo (Japan)). Mar 1988. 450p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88756848/JAW.

Results of the survey on the ASIAN coal producing countries are reported. Domestic consumption in Indonesia will increase to 7,215,000 tons in 1990 because of operation onset of some large coal-fired power plants and new/expansion plans, resulting a shortage of 105,000 tons. Therefore, the production will largely be increased to reach 17,610,000 tons in 1995, giving an export surplus of 4,078,000 tons. The Omblin pitch blend of Middle Sumatra and Kalimantan Old Tertiary coal with characteristic moisture less than 6% and Kalimantan New Tertiary coal with moisture 6-9% are acceptable on the criteria for import by Japanese power plants. The Philippines will still be an import country in 2000. Thailand produces brown coal only and it is still not acceptable in Japan. Coal production is being suspended in Malaysia, and the quality is too low for export to Japan. Demands on coals in ASIAN countries may be raised depending upon the oil price. Indonesia will be a big exporting country in this area if the coal price is internationally competitive. (130 figs, 110 tabs, 163 refs.)

21679 **(NEDOJ—8805) Report of the investigation on the expansion of Pacific coal flow in FY 1987.** (Institute of Energy Economics, Tokyo (Japan)). Mar 1988. 249p. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88756851/JAW.

An investigation was conducted on the expansion of coal flow in the Pacific region in FY 1987. The coal import by Asian countries, including Japan, has rapidly increased in 1980s, showing 82 million tons as raw material and 49 million tons as general coal in 1985, most of which is attributed to the increase in general coal. Australia supplies about a half of the import, followed by U.S and Canada. Growth of import from Canada and South Africa are significant. Import of raw material coal by Asian countries including Japan is estimated to be 77 million tons and general coal to be 126 million tons in 2000. Australia will be still the top supplier with decline of Canada and the U.S., South Africa has a potential although its political situation is unstable. Export from China will increase. Although a crisis of coal demand/supply is feared for 1990s, it can be averted by efforts of the countries involved, especially by policies of Japan. (16 figs, 142 tabs, 92 refs.)

0160 Health And Safety

21680 **(IOM-TM—87-07) Realisation of a practical inspirable dust spectrometer.** Vincent, J.H.; Mark, D.; Botham, R.A.; Lynch, G.; Aitken, R.J.; Gibson, H.; Campbell, S. (Institute of Occupational Medicine, Edinburgh (UK)). Dec 1987. 91p. Institute of Occupational Medicine, Edinburgh (UK).

This project set out to develop new instrumentation for dust measurement in mines upon which to base a better understanding of the factors leading to disease and, in turn, improved standards setting and environmental conditions. The general aim has been to bring to practical realisation the dust spectrometer whose potential had been established in a previous CEC-funded project. The resulting instrument (SIDS) is an eight-stage cascade impactor based on the principle of rectangular jets impinging onto rotating drums. It incorporates an entry which aspirates the inspirable fraction of the ambient airborne dust. Thus it can provide the particle aerodynamic size distribution of the inspirable fraction and so enable determination of the particle size distributions and airborne mass concentrations of any subfraction relevant to health (e.g., thoracic, respirable). It can also provide aerodynamically-classified dust samples suitable for mineralogical analysis. As a result of the rotating-drum feature, such information may be obtained for time increments within individual working shifts. The instrument is a static sampler, intended for fixed-point operation. Trials with the instrument were conducted both in the laboratory and underground in a coalmine. It was demonstrated how it could provide the wide range of information about inspirable dust and the various health-related subfractions. After some initial technical difficulties, the instrument performed well. It has since featured in a CEC-funded joint dust sampling project, and the results of this exercise will be reported separately.

21681 **(IOM-TM—87-11) A case-control study of reasons for unusual radiological changes of pneumoconiosis among individual mineworkers.** Robertson, A.; Hurley, J.F.; Brown P.W.; Collins, H.P.R.; Dodgson, J.; MacLaren, W.M. (Institute of Occupational Medicine, Edinburgh (UK)). Jul 1987. 141p. Institute of Occupational Medicine, Edinburgh (UK).

The main objective of this study was to investigate the environmental factors associated with rapid progression of coalworkers' simple pneumoconiosis (CWSP) and progressive massive fibrosis (PMF). A second, subsidiary aim was to describe the occurrence of rapid progression and PMF throughout Britain. The research was carried out in two separate but related phases. In the first, the distributions of new occurrences of rapid progression of CWSP and PMF throughout Britain in the 1970s were investigated. A more intensive case-control study of some of these men was then undertaken to investigate the environmental factors associated with these radiological changes. Geographical distribution of both pathological conditions are given, as well as the susceptible age. Results of the study also demonstrated that the diseases are closely related to chronic exposure to dusty environment. Quartz was also implicated.

21682 **(IOM-TM—87-16) Utilisation of accident data to improve safety in the human factors aspects of system design.** Graveling, R.A.; Mason, S.; Rushworth, A.M.; Simpson, G.C.; Sims, M.T. (Institute of Occupational Medicine, Edinburgh (UK)). Dec 1987. 82p. Institute of Occupational Medicine, Edinburgh (UK).

The project examined the British Coal accident reporting system (which was first introduced over 20 years ago as a manual system but which now incorporates computer database and retrieval systems) to identify how well it covered behavioural components, how any shortfall could be improved and the extent to which existing information could be used to identify avenues for accident prevention measures.

21683 **(IOM-TM—88-02) The variability of exposure of coalminers to inspirable dust.** Mark, D.; Cowie, H.; Vincent, J.H.; Gibson, H.; Lynch, G.; Garland, R.; Weston, P.; Bodsworth, P.; Witherspoon, W.A.; Campbell, S.; Dodgson, J. (Institute of Occupational Medicine, Edinburgh (UK)). Jan 1988. 167p. Institute of Occupational Medicine, Edinburgh (UK).

The project sets out to provide information about the variability of exposure of coalminers to fractions of airborne dust containing particles that are coarser than those contained within the respirable subfraction. This is to enable progress to be made in epidemiological research studies relating exposure to various dust subfractions and the incidence of upper airways disease. The philosophy adopted for the choice of dust sampling instrument used for this investigation was that it should simulate the nature of human dust exposure for all relevant particle sizes. This includes sampling of 'total' airborne dust according to the definition of inspirable particles (i.e., those which may enter through the nose and/or mouth during breathing) and the subsequent selection of biologically-relevant subfractions representing deposition of particles in the various anatomical regions of the respiratory tract. The question arises: can

a reliable measurement of the individual exposure of a coalminer to inspirable dust be obtained by using a static sampler, or should a properly-designed personal sampler be used? Also: what are the relationships between inspirable dust and the various subfractions referred to (e.g., thoracic, tracheobronchial, respirable)? The main objective of the project was to provide answers to these questions.

21684 **(IOM-TM—88-07) Biochemical studies of the pathogenesis of emphysema in men in the British coal industry.** Cullen R.T.; Love, R.G.; Cowie, H.A.; Parker, I.; Hannant, D.; Collins, H.P.R.; Soutar, C.A. (Institute of Occupational Medicine, Edinburgh (UK)). Nov 1988. 90p. Institute of Occupational Medicine, Edinburgh (UK).

In coalminers, exposure to respirable dusts is associated with impairment of lung function, which may in part represent emphysema since the frequency of emphysema in coalminers is higher than in other occupational groups. The cross-sectional study reported here set out to determine whether free elastase activity in sputum was related to lung function and radiographic evidence of emphysema in coalminers from three geographic areas of Britain. A total of 282 miners and 57 PO/Telecom men provided sputum samples, and were given chest radiographs and lung function tests. The principal findings were that raised sputum elastase levels were associated with impaired lung function; sputum elastase levels were not associated with lifetime cumulative exposure to coalmine dust; most of the elastase was derived from neutrophils; the level of alpha-1-antiprotease (α1Pi) (the major serum inhibitor of neutrophil-derived elastase) increased with age, and overall α1Pi tended to decrease as dust exposure increased; and current smoking was associated with low levels of total, but not of free, sputum elastase.

21685 **(IOM-TM—88-10) Epidemiological and clinical studies of back pain in the mining industry.** Agius, R.M.; Lloyd, M.H.; Campbell, S.J.; Graveling, R.A.; Hutchison, P.A.; Muirhead, M.J.; Gurr, D.; Soutar, C.A. (Institute of Occupational Medicine, Edinburgh (UK)). Nov 1988. 189p. Institute of Occupational Medicine, Edinburgh (United Kingdom).

Epidemiological, clinical and ergonomic studies of back pain in the mining industry are described. The aims of the studies were to determine whether the prevalence of back pain amongst miners was higher than amongst a control group of workers, whether back pain was associated with particular named occupations or work areas in mining, whether certain characteristics of the individuals may be associated with increased susceptibility to back pain and what relationship existed between postures and movements and the incidence of back pain. Prevalence of back pain was studied by a cross sectional study in Scotland involving 359 colliery workers and 181 male employees of a neighbouring office. 69% of the colliery workers and 58% of the office workers reported suffering back pain at some time in their lives. Association of back pain with named occupations in the pit was first studied at a Welsh colliery where, of the 780 men who completed a questionnaire, lifetime prevalence of back pain increased with age up to the 5th decade and then fell. The prevalence was highest amongst men engaged in underground transport, deputies and overmen, and general surface workers. A further study at two English collieries found that 60% of the 119 underground workers at the pit with predominantly overhead men or rail transport and 66% of the 73 underground workers at the pit with conventional haulage had a history of back pain. The anthropometric studies showed no significant difference between back pain cases and controls, except that controls had greater mobility of the lower spine than cases.

21686 **(IOM-TM—88-13) Working in hot conditions in mining: a literature review.** Graveling, R.A.; Morris, L.A.; Graves, R.J. (Institute of Occupational Medicine, Edinburgh (UK)). Oct 1988. 122p. Institute of Occupational Medicine, Edinburgh (UK).

The review includes a brief overview of thermal physiology; environmental and metabolic heat loads and the physiological and behavioural responses to such loads. It also encompasses methods for the assessment of hot conditions either directly, through the measurement of physiological strain, or indirectly via thermal indices. These elements are then examined in the context of UK mining conditions with sections on the thermal and metabolic heat loads reported in coal and potash mines and an assessment of those thermal indices which suitably reflect the potential effects of such loadings. Fluctuations in environmental heat load are reported, both over time and between adjacent locations. The review draws attention to the need to take both these fluctuations and those of metabolic heat load into account in formulating a method for determining and evaluating the likely degree of thermal stress. The calculated thermal stress will usually be evaluated against some form of Standard or criterion. The review examines those Standards etc. already in use and concludes that, depending upon work rate and pattern, an action limit of between 27 and 31 degrees C BET (Basic Effective Temperature) can be applied. Finally the review examines various control measures such as refrigeration and personal cooling for their potential impact on the workforce. It concludes that many of those currently employed have some merit although many can have undesirable 'side-effects'. For example, local cooling can create problems elsewhere underground where the extracted heat is discharged.

21687 **(IOM-TM—88-17) Pneumoconiosis in coalminers and exposure to dust of variable quartz content.** Miller, B.G.; Kinnear, A.G. (Institute of Occupational Medicine, Edinburgh (UK)). Nov 1988. 129p. Institute of Occupational Medicine, Edinburgh (UK).

This report describes the design and execution of a study in which existing radiographs for men at a colliery in Midlothian were subjected to intensive re-examination, with the objective of relating any evidence of radiographic abnormalities to data already held on the individual men's exposures to respirable airborne dust in the coalmine, and on lung function and smoking habits. All available radiographs from over 1400 men employed at that colliery who had attended any of the British National Coal Board's Pneumoconiosis Field Research surveys in 1970, 1974 and 1978 were collected; these were classified for pneumoconiotic abnormalities according to the ILO (1980) scheme, by an experienced panel of non-medical readers reading each radiograph independently and in randomised order, on two separate occasions. Analyses of the data from these classifications, using the statistical techniques of logistic regression, confirmed that appearances of small pneumoconiotic shadows of profusion at least 1/0 on the ILO (1980) scale were associated most strongly with the estimates of individuals' exposures to respirable coalmine dusts from before the 1970 to after the 1974 surveys, and particularly with estimates of exposures to the quartz components of these dusts. There was no evidence that the men's smoking habits were an important modifying factor in this association. Lung function variables measured at the surveys were analysed using linear regression techniques to adjust for age and smoking habits as necessary. These analyses suggested that a slightly higher rate of loss of lung function between 1974 and 1978 was experienced by men with higher exposures to the non-quartz fraction of the dust. Changes in lung function observed between the 1970 and 1974 data did not, however, show such an association.

21688 **(NP—9770315) Development of a device for the automatic control of wetting during application of pneumatically conveyed dry construction materials - preliminary phase. Final report.** Krause, P. (Ruhrkohle A.G., Essen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). May 1988. 40p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770315/JAW.

By the increasing use of pneumatically conveyed dry construction materials in the mining industry ultra-fine dusts are released which additionally burden workplace conditions. By the development of an automatic device controlling water addition during the pneumatic application of these construction materials, hazards to miners by the release of ultra-fine dusts are to be precluded as far as possible. Based on a specification three manufacturers elaborated their suggestions - in the form of preliminary project studies - for the design and manufacturing of measuring and control instruments. (orig.) With 15 figs.

21689 **(NRPB-R—203) Radiation doses from coal-fired plants in Oxfordshire and Berkshire.** Wan, S.L.; Wrixon, A.D. (National Radiological Protection Board, Didcot (UK)). Dec 1988. 19p. National Radiological Protection Board, Didcot (United Kingdom).

This report contains an assessment of the radiation doses to members of the public living in Oxfordshire and Berkshire from the releases to atmosphere of natural radioactivity from Didcot Power Station and the coal-fired boilers that operate at the Atomic Weapons Establishment (AWE) at Aldermaston and the Harwell Laboratory of UKAEA. It complements an earlier report on the doses from all significant sources of radiation exposure to members of the public living around AWE, Aldermaston, the Royal Ordnance Factory at Burghfield and the Harwell Laboratory. Both reports were prepared to assist the Committee on Medical Aspects of Radiation in the Environment (COMARE) in its work to review the evidence on whether there is a causal relationship between radiation exposure and alleged increases of the incidence of leukaemia. The calculated annual effective dose equivalents to adults from the emissions from Didcot Power Station and the coal-fired plants at AWE, Aldermaston, and UKAEA, Harwell, at 5 km from the sites are, respectively, 0.3, 0.06 and 0.01 μSv. The doses to red bone marrow are broadly comparable with these values. The doses to the other age groups considered (1-year-old and 10-year-old children) are similar to those to the adults. The conclusion is therefore drawn that the discharges from the coal-fired plants make a negligible contribution to the total radiation doses received by the population living around the sites. 29 refs., 12 tabs.

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 22317, 22318

21690 **(CEGB-TPRD-L—3240-R87) Gaseous emissions: conversion between standard conditions.** Sloan, S.A. (Central Electricity Research Labs., Leatherhead (UK)). Feb 1988. 27p. Central Electricity Research Labs., Leatherhead, UK.

Legislation on flue gas emissions will be framed in terms of maximum allowable concentrations of specific species. However, since the absolute composition of flue gas depends on the quantity of excess air diluting the combustion products, the emission limits will be stated at a standardized dilution. The organizations and regulatory bodies involved have traditionally expressed their emissions at different standard conditions, and in order to standardize emission limits it is necessary to accurately convert between them. A notation is presented allowing the ready interconversion without deep consideration of the flue gas conditions. The results are tabulated separately for either coal-firing or oil-firing for emissions of SO_2, NO/sub x/ or HCl.

02 PETROLEUM

21691 **(UCID—21664) Rock-Eval analysis of LLNL samples by industrial sponsors: Part 1, S2 and T/sub max/.** Burnham, A.K. (Lawrence Livermore National Lab., CA (USA)). Mar 1989. Contract W-7405-ENG-48. 11p. NTIS, PC A03 - OSTI. Order Number DE89009011/JAW.

This report summarizes T/sub max/ and S2 results obtained from six LLNL Industrial Sponsors and three other laboratories for a set of rock samples provided by LLNL. The principal objective of this work was to characterize samples that would be useful subsequently in establishing standards for kinetic analysis. We found that the T/sub max/ values from the various laboratories were more consistent than the S2 values. The standard deviation between the average T/sub max/ values from different laboratories was about 3{degree}C for all samples, independent of particle size. T/sub max/ tended to decrease about 4{degree}C as sample size increased from 25 mg to 100 mg. Sample size effects for S2 were much smaller than systematic differences between laboratories. Sample size effects were about 10%, while the highest and lowest laboratory values varied typically by a factor of 1.7. 5 refs, 3 tabs.

0201 Reserves

REFER ALSO TO CITATION(S) 21625, 22314

21692 **(DOE/FE—0118) Naval petroleum & oil shale reserves annual report of operations FY1988.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of Petroleum Reserves). 1988. 46p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008935/JAW.

A brief description of activities for FY1988 from the naval petroleum and oil shale reserves is presented. Production, sales, revenues and expenditure figures are included. 18 figs. (CBS)

0202 Geology And Exploration

21693 **(DOE/ER/13466—3) Organic geochemistry of continental margin and deep ocean sediments: Progress report, 2 January 1988--28 February 1989.** Whelan, J.K.; Hunt, J.M.; Hennet, R.; Tarafa, M.E.; Dickinson. P.A.; Johnson, C. (Woods Hole Oceanographic Institution, MA (USA)). Oct 1988. Contract FG02-86ER13466. 87p. (COO—13466-3). NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009142/JAW.

Our research involves the origin, accumulation, maturation, and migration of petroleum. We have continued to focus our efforts this past grant year on continuing studies in the Alaskan North Slope (NPRA), and the US Gulf Coast, particularly examination of down-hole profiles of organic geochemical parameters in the context of regional processes thought to have occurred over geologic time. Both areas are and will remain important domestic oil and gas production areas in the forseeable future. Our research during the past year has involved several exploratory studies on samples from the Gulf Coast and the Alaskan North Slope. An extensive sample and data collection for the Alaskan North Slope Naval Petroleum Reserve became available through collaborative work with Drs. Les Magoon and Ken Bird of the US Geological Survey. This resource has provided us with a "library" of marine sediments of various types and thermal maturities for our research, with which it has been possible to address a number of basic questions about petroleum geochemical processes.

21694 **(FRNC-TH—3432) Markov models in computer vision: application to seismic image interpretation.** Barraquand, J. (Nice Univ., 06 (France)). Jan 1988. 270p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88757212/JAW.

The aim of this work is the realization of a system for hydrocarbon detection. Surface of constant geologic age are reconstructed using the Frobenius theorem. Geologic age of stratigraphic layers is considered as the solution of an elliptic partial differential equation and algorithms are given. Experimental results show the efficiency of the method for detection of faults and stratigraphic traps.

21695 **(NDE—8806) Oil and gas resources of Newfoundland and Labrador.** (Newfoundland Dept. of Energy, St. John's (Canada)). 1988. 31p. (MICROLOG—88-05207). Dept. of Mines and Energy, PO Box 4750, St. John's, NF, Canada A1C 5T7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report presents information about petroleum exploration and development in Newfoundland and Labrador, outlines the importance of the oil and gas resource which lies in the Newfoundland continental margin, and summarizes recent events which relate to the province's hydrocarbon potential. Legislative and administrative aspects, including the federal/provincial Atlantic Accord on offshore resources, and the geological setting are described. The development prospects currently in view are the Hibernia and Terra Nova projects on the Grand Banks. Refinery operations are represented by the reactivation of the facility in Come-By-Chance. A summary of major development projects approved to date, and a glossary of terms, are also included. 18 figs., 6 tabs.

21696 **(NIPER—378) Determining petrophysical properties of reservoir rocks by image analysis.** Tomutsa, L.; Brinkmeyer, A.; Raible, C. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Mar 1989. Contract FC22-83FE60149. 30p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000734/JAW.

The objective of this work is to study pore structures and develop methods for computerized petrographic image analysis to quantify the relationships between pore parameters and petrophysical properties of rocks. Petrographic image analysis (PIA) offers a relatively new technique for measurements of shapes, surface areas, and size distributions of rock pores and size/shape of rock grains. We have developed a methodology for measuring each of these petrophysical features using commercially available equipment. This information can be used to describe porosity and lithologic heterogeneities within a reservoir. Permeability is a function of the three-dimensional pore network in a rock and cannot be measured directly from two-dimensional PIA data. However, rock parameters, such as porosity and specific surface values, can be measured by PIA. We have used the Carman-Kozeny model for flow-through porous media to estimate permeability using PIA data for porosity and specific surface. This report describes the equipment and software necessary for image analyses, the application of image data to measurements of rock properties, and the initial correlation of image analysis data to petrophysical properties. 4 refs., 7 figs., 5 tabs.

21697 **(NP—9770316) Development of a seismic measuring method for broadband signals. Final report.** Edelmann, H.A.K. (Prakla-Seismos G.m.b.H., Hannover (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1 Nov 1988. 38p. (In German). NTIS (US Sales Only), PC A03. Order Number DE89770316/JAW.

The project was finished as scheduled. Under the scope of the project investigations were made to delineate effects which limit the bandwidth of seismic reflection recording and processing. The broadband behaviour of the vibrator was improved and experiments were made to find out the limitations imposed by baseplate coupling. The local effects which necessitate complex static corrections were investigated and measurements were made to take this into account, applying decomposed patterns. The increase in vertical resolution demands a similar improvement in horizontal directions. The Global Positioning System therefore was tested for land seismic surveys. The method can be applied for all kinds of reflection seismic measurements. (orig.) With 6 refs., 1 tab., 6 figs.

21698 **Laboratory measurements of electrical resistivity at reservoir conditions.** Mahmood, S.M.; Maerefat, N.L.; Chang, M.M. (National Institute for Petroleum and Energy Research (US)). pp v of Proceedings of the 1988 SPE 63rd annual technical conference and exhibition. Richardson, TX; Society of Petroleum Engineers (1988). (CONF-881012—).

From 63. Society of Petroleum Engineers (SPE) annual technical conference and exhibition: reservoir engineering; Houston, TX, USA (2 Oct 1988).

An experimental study was performed to investigate the influence of variations in test conditions and laboratory procedures on the electrical properties of rocks. The temperatures and confining pressures were varied from 75° to 150°F and from 500 to 6,000 psi, respectively. The brine salinity was changed from 2% to 10% of NaCl. Two different saturation procedures were followed in saturating cores to determine the effects of variability in the procedures. This study provides some insight to the complications involved in laboratory measurements of the electrical resistivity of rocks under simulated reservoir conditions. It also contributes in understanding the combined effects of temperature and pressure on electrical resistivity.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 23892

21699 **(DOE/FE—0123) Enhanced Oil Recovery program plan, FY 1988.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of the Deputy Assistant Secretary for Oil, Gas, Shale and Special Technologies). Jun 1988. 35p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008952/JAW.

Last year, Fossil Energy staff met with 102 individuals representing 24 organizations to draft a new research agenda for enhanced oil recovery--the "EOR Initiative." This report was reviewed by Fossil Energy's Office of Geoscience Research and DOE's Hydrocarbon Geoscience Coordinating Committee. Much of the research agenda presented there is already included in this EOR program plan. In addition, the "EOR Initiative" has been an important factor in formulating the priorities for future budget requests for enhanced oil recovery. 9 refs., 6 figs., 1 tab.

21700 **(LBL—25056) An analytical solution for wellbore heat transmission in layered formations.** Wu, Yu-Shu; Pruess, K. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 39p. (CONF-880380—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008175/JAW.

From Society of Petroleum Engineers California regional meeting; Long Beach, CA, USA (23 Mar 1988).

This paper presents an analytical method for determining wellbore heat transmission during liquid or gas flow along the tubing. The mathematical model describes the heat transfer of the flowing fluid in the wellbore and in the surrounding formation as one whole physical system. The transient heat transfer equations in the two regions with coupling at the sandface are solved simultaneously. Previous treatments of wellbore heat transmission are improved upon in several aspects. Non-homogeneous formations are treated which consist of several layers with different physical properties and arbitrary initial temperature distributions in the vertical direction. Closed form analytical solutions are obtained in real space and in Laplace space, which can be used to calculate the temperature distribution along the wellbore and in the formation, and to evaluate heat transfer rate and cumulative heat exchange between wellbore and formation. A more accurate formula is given for the widely-used transient heat conduction function f(t/sub D/) of thermal resistance. This is shown to differ from Ramey's approximate solution at early time, while approaching it at late time. 14 refs., 10 figs., 1 tab.

21701 **(LBL—25523) WES: A well test analysis expert system.** Mensch, A. (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 185p. NTIS, PC A09/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008861/JAW.

This report describes part of the development of an expert system in the domain of well-test analysis. This work has been done during my final internship, completed at the Lawrence Berkeley Laboratory. The report is divided in three parts: the first one gives a description of the state of the project at the time I first began to work on it, and raises some problems that have to be solved. The second section shows the results that have been reached, and the last one draws conclusions from these results and proposes extensions that would be useful in the future.

21702 **(NIPER—326) Simulation of production from wells with horizontal/slanted laterals: Final report.** Chang, Ming-Ming. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Mar 1989. Contract FC22-83FE60149. 41p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000711/JAW.

A horizontal and slanted well model was developed and incorporated into BOAST, a black oil simulator, to predict the potential production rates for such wells. The slanted/horizontal well model can be used to calculate the productivity index, based on the length and location of the wellbore within the block, for each reservoir grid block penetrated by the slanted/horizontal wellbore.

The well model can be run under either pressures or rate constraints in which wellbore pressures can be calculated as an option of infinite-conductivity. The model is easy to use and can simulate the performance of multiple horizontal/slanted wells in any geometric combination within reservoirs. The model was checked against the analytical formulas of transient wellbore pressure in an infinite slab reservoir. Production rates from vertical wells, horizontal wells, and slanted wells of variable well lengths in a field of 40-acre well spacing were also compared. A field simulation of a horizontal well and its three offset conventional vertical wells demonstrated the application of the developed well model. 31 refs., 18 figs., 15 tabs.

21703 **(NIPER—392) The effects of viscous forces on three-phase relative permeability.** Maloney, D.R.; Mahmood, S.M.; Honarpour, M.M. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Apr 1989. Contract FC22-83FE60149. 69p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000737/JAW.

The overall objective of Three-Phase Relative Permeability Project (BE9) is to develop guidelines for improving the accuracy of three-phase relative permeability determinations. This report summarizes previous studies and explains the progress made at NIPER on studying the effect of variations in viscous forces on three-phase relative permeabilities by changing the viscosity of both wetting and nonwetting phases. Significant changes were observed due to viscosity variations. An increase in oil viscosity reduced the relative permeability to gas; an increase in brine/(wetting-phase) viscosity reduced the relative permeability to brine. A slight increase in gas relative permeability was also observed. These observations suggest that the viscosities of both oil and water influence three-phase permeability data. During this study, data scatter was sometimes encountered which was comparable to that of published results. The causes of this scatter are outlined in this report and remedial attempts are discussed. 20 refs., 16 figs., 5 tabs.

21704 **(NP—9770298) Polymers for enhanced oil recovery. Final report.** Schmitz, H. (Cassella A.G., Frankfurt am Main (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jan 1988. 17p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770298/JAW.

We succeeded in developing a new technical process for the production of salt and temperature stable polymers which previously were available only on a lab-scale. A special finishing method was also upgraded into technical scale and further improved to achieve the best form of application of the polymers. Material and equipment problems, as well as process control difficulties that became apparent during the development of the technical process could be resolved satisfactorily. The pilot plant was extensively tested by water- and product-runs, thereby continuously improving and rationalizing the total process. The performance of the product was standardized and optimized during the scale-up. Finally the pilot plant and the process were brought to full ability of function and efficiency concerning quality and quantity of product. Thus the essential problems were resolved and the projected goals were achieved. (orig.) With 11 refs., 2 tabs., 1 fig.

21705 **(ORNL/TM—11124) The Replacement Cost Integration Program: User's guide.** Reister, D.B. (Oak Ridge National Lab., TN (USA)). Mar 1989. Contract AC05-84OR21400. 32p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008982/JAW.

The Oak Ridge National Laboratory and subcontractor ICF-Lewin Energy have developed a set of computer models to forecast the replacement cost of domestic crude oil. The REPCO model forecasts the replacement cost in the lower 48 states. The Arctic Economics Model forecasts the replacement cost in Alaska. The two models of the replacement cost system forecast domestic crude oil supply curves (schedules of the amount of oil available at various costs). The Replacement Cost Integration Program (RCIP) integrates the output from the two models to forecast the annual discoveries and production of domestic crude oil. RCIP is a user-friendly menu-driven program that is designed to run on an IBM-PC. This user's guide for RCIP contains detailed directions for installing and operating RCIP. The guide discusses all of the parameters on the input screens of the model. The format and units of the output files of the model are reviewed in Appendix B.

21706 **(ORNL/TM—11132) Replacement Cost Integration Program Model Description.** Reister, D.B. (Oak Ridge National Lab., TN (USA)). Mar 1989. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008984/JAW.

The Oak Ridge National Laboratory and subcontractor ICF-Lewin Energy have developed a set of computer models to forecast the replacement cost of domestic crude oil. The Replacement Cost model forecasts the replacement cost in the lower 48 states: the Arctic Economics Model forecasts the replacement cost in Alaska. The two models of the replacement cost system forecast domestic oil supply curves (schedules of the amount of oil available at various costs). The Replacement Cost Integration Program (RCIP) integrates the output from the two models to forecast the annual discoveries and production of domestic crude oil. RCIP is a user-friendly, menu-driven program designed to run on an IBM personal computer. RCIP allows the user to conveniently edit the input parameters, to calculate the results and to display the output. In addition, the user can easily store a scenario on a disk and retrieve a scenario from the disk. The built-in output editor allows the user to choose an aggregation scheme for the regional results and retrieve a scenario for comparison. The output can be directed to a file or to the screen. This Model Description provides an introduction to the models and presents a mathematical description of the oil supply model and of the drilling model. 13 refs., 1 fig.

21707 **(SAND—88-2313C) Steam-zone electrical characteristics for geodiagnostic evaluation of steamflood performance.** Mansure, A.J. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 14p. (CONF-890495—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005333/JAW.

From Society of Petroleum Engineers (SPE) California regional meeting; Bakersfield, CA, USA (5 Apr 1989).

An essential part of the development of electrical geodiagnostic techniques for mapping thermal recovery processes is understanding the relationship of formation resisitivity to the thermal recovery process. As a result of laboratory measurements of a one-dimensional steamflood, a preliminary understanding of some of the mechanisms of the electrical resistivity change has been gained. The theory of electrical resistivity of a steamflood is reviewed and used to evaluate the resistivity changes expected. A conceptual electrical model of a steamflooded porous reservoir is presented. This conceptual model is based on a qualitative description of the fluid zones of an ideal heavy oil steamflood. The model assumes that salinity, temperature, and saturation are the important factors controlling the resistivity changes, and that Archie's law applies. It is found that the characteristic of each individual reservoir must be considered before the in situ resistivity changes are predicted, and that the in situ resistivity can either increase or decrease as a result of steamflooding. 25 refs., 5 figs., 2 tabs.

21708 **Effects of reservoir heterogeneity on chemically enhanced oil recovery.** pp v of Surfactant/polymer chemical flooding. Volumes 1-2. Richardson, TX; Society of Petroleum Engineers (1988).

A three-dimensional, multiphase, multi-component micellar-polymer flooding simulator has been used to investigate the process performance under different conditions of reservoir heterogeneity (stratifications) and mobility ratio. The significance of crossflow has been studied by relating the chemical flood recoveries to the effective length to thickness ratio and the transverse dispersion number of the reservoir. A long standing question in micellar-polymer flooding concerns whether small, high concentration chemical slugs are preferred to large lower concentration slugs. This aspect of slug size vs. slug concentration has been studied in three dimensions in the presence of heterogeneity. Finally, chromatographic separation of surfactant and alcohol has been investigated and discussed. It is found that a salinity gradient can be tailored to minimize this separation tendency and in fact this is the single most important factor even compared to adsorption and partitioning. This is a highly favorable result which can and should be exploited to improve the practical design of micellar-polymer floods.

0204 Processing

REFER ALSO TO CITATION(S) 21619, 21622, 21627, 21734

21709 **(LA-UR—89-833) Using PC-based shells to write an expert assistance for use with the ASPEN [Advanced System for Process ENgineering] computer code.** Parkinson, W.J.; Luger, G.F.; Bretz, R.E. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 36p. (CONF-8904136—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009396/JAW.

From Applications of artificial intelligence in chemical engineering; Houston, TX, USA (2 Apr 1989).

Many engineers argue against using expert systems to solve problems because of the relatively high cost of specialized LISP machines and the large expert system shells written for them. This paper demonstrates how small, but useful, expert systems can be written with inexpensive shells and run on inexpensive personal computers (PCs). Two such shells are CLIPS and EXSHELL. CLIPS, developed by NASA, is a forward-chaining, rule-based system. It is written in the C language, but the rules are entered in a LISP-like format. EXSHELL, developed by the Computer Science Department at the University of New Mexico, is a backward-chaining, rule-based system written in PROLOG. Each of these shells was used to write an expert assistant to aid the design engineer in using the ASPEN (Advanced System for Process ENgineering) computer code. ASPEN is a large computer code used to design chemical plants and refineries. Among other things, ASPEN computes mass and energy balances for the plant design. Unfortunately, an expert, or several experts, are required to use ASPEN to its full potential. For example, choosing the proper thermodynamic package to represent a given process is important in developing the correct mass and energy balances. An ASPEN user may be an expert in plant design, yet may not be expert enough at thermodynamics to pick the proper package from the many offered by ASPEN. CLIPS and EXSHELL were used to develop a useful expert assistant to help process plant designers pick the proper thermodynamic package to be used with particular operating conditions at various points in the ASPEN plant simulation. This paper also demonstrates the utility and ease of use of these inexpensive shells and compares the approach used by each. 11 refs., 12 figs.

21710 **Effect of prehydrogenation on hydroconversion of Maya residuum, Part I.** Reynolds, J.G.; Beret, S. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA (US); Chevron Research Co., Richmond, CA (US)). *Fuel Science and Technology International;* 7: No. 2, 165-186(Feb 1989).

Maya 650°F residuum was mildly prehydrogenated over a standard, commercially available, hydrdesulfurization catalyst. The product was then distilled to yield hydrogenated Maya 650°F residuum. This prehydrogenated residuum, and the untreated Maya 650°F residuum were separately hydroprocessed further at different process severities. The resulting products were then examined by elemental analyses to determine the effects of the prehydrogenation step on overall conversion and product quality. The primary effect of the prehydrogenation step was to increase the overall conversions for sulfur, MCR, nitrogen, and asphaltenes. As a result, the hydroconversion products derived from the prehydrogenation were substantially better quality than the corresponding direct hydroconversion products. The prehydrogenation step also lowered the severity required for equivalent residuum hydroconversion upgrading.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 21705, 21706

21711 **(AE—1987) Investment opportunities in oil and gas in Alberta, Canada.** (Alberta Energy, Edmonton (Canada)). [1987]. 17p. (MICROLOG—88-03186). Dept. of Energy, Petroleum Plaza Twr., 9915-108 St., Edmonton, AB, Canada T5K 2C9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The attractiveness of Alberta to those interested in investing in the oil and gas industry is promoted in this document. The province's hydrocarbon reserves are briefly outlined, along with the role of the Alberta government (and its agencies such as the Alberta Department of Energy and the Energy Resources Conservation Board) in developing such resources. Production and marketing opportunities are examined for conventional crude oil, oil from enhanced recovery processes, heavy oil, natural gas, oil sands, and petrochemical and related products. Some government programs to stimulate economic activity in the industry are mentioned. 27 figs.

21712 **(DOE/EIA—0109(89/01)) Petroleum supply monthly, January 1989.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Mar 1989. 145p. NTIS, PC A07/MF A01 - GPO - OSTI; 1; GPO Dep. Order Number DE89009229/JAW.

The Petroleum Supply Monthly (PSM) is one of a family of three publications produced by the Petroleum Supply Division within the Energy Information Administration (EIA) reflecting different levels of data timeliness and completeness. The other two publications are the Weekly Petroleum Status Report (WPSR) and the Petroleum Supply Annual (PSA). Data presented in the PSM describe the supply and disposition of petroleum products in the United States and major US geographic regions. The data series describe production, imports and exports, inter-Petroleum Administration for Defense (PAD) District movements, and inventories by the primary suppliers of petroleum products in the United States (50 states and the District of Columbia). The reporting universe includes those petroleum sectors in "Primary Supply." Included are: petroleum refiners, motor gasoline blenders, operators of natural gas processing plants and fractionators, inter-PAD transporters, importers, and major inventory holders of petroleum products and crude oil. When aggregated, the data reported by these sectors approximately represent the consumption of petroleum products in the United States. Data presented in the PSM are divided into two sections: (1) the Summary Statistics and (2) the Detailed Statistics. 12 figs., 46 tabs.

21713 **(DOE/EIA—0520(89/03)) International petroleum statistics report.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 24 Mar 1989. 42p. NTIS, PC A03/MF A01 - GPO - OSTI; 1; GPO Dep. Order Number DE89008754/JAW.

The International Petroleum Statistics Report is a monthly publication that provides current international oil data. This report is published for the use of Members of Congress, Federal agencies, State agencies, industry, and the general public. The International Petroleum Statistics Report presents data on international oil production, consumption, imports, exports, and stocks. The report has three sections. Section 1 contains time series on world oil production, and on oil consumption and stocks in the Organization for Economic Cooperation and Development (OECD). This section contains annual data beginning in 1973, and monthly data for the most recent two years. Section 2 presents an oil supply/consumption balance for the market economies (i.e., non-Communist countries). This balance is presented in quarterly intervals for the most recent two years. Section 3 presents data on oil imports by OECD countries. This section contains annual data beginning in 1982, and quarterly data for the most recent two years. 23 tabs.

21714 **(Juel—2209) Considerations on the longer-term availability of petroleum.** Runge, H.C.; Moenig, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Forschungsgruppe Wirtschaft, Energie, Investitionen). Jun 1988. 74p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88757384/JAW.

The work of the study group for System Research and Technological Development (STE) at the Nuclear Research Centre Juelich GmbH (KFA) on the investigation of 'New types of horizontally integrated energy-systems' (NHIES) with considerably reduced noxious emissions in energy conversion and consumption are aimed long-term at the substitution in particular of mineral oil production by synthetically produced liquid energy carriers. In the course of work on this programme it became increasingly clear,

however, that the vertically subdivided energy systems are also capable of meeting considerably strengthened quality requirements for the protection of the environment in production, conversion and consumption. This is true especially in the case of petroleum and its mineral oil products. Out of the emerging competitive situation between conventional 'vertical' and the new 'horizontal' energy systems the question which is gaining in importance for the KFA is, in what time period will the growing world-wide need for liquid energy carriers reach and overtake the possible supply of mineral oil products. From this situation a broadly diversified demand for synthetically produced liquid energy carriers is likely to develop.

21715 **(NEDOJ-P—8725) Econometric analysis on oil substituting energy.** (New Energy and Industrial Technology Development Organization, Tokyo (Japan)). May 1988. 259p. (In Japanese). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88756488/JAW.

The comprehensive model, dealing with the framework of Japan's total energy demand and supply, has been further strengthened to the model by adding models of economic and industrial structure frame and new energy costs and secondary energy prices which were exogenously given so far in our study. The model consists of economic model, new energy cost model, and the energy demand and supply model. The economic model can further be broken down into macro ecomomic model and industrial input output model. Simulation period set was 24 years from 1987 to 2010, and summary of the simulation results are as follows: in low price case, the real annual economic growth rate is 2.8 % and in high price case, the growth rate is 0.2 point lower. New energy supply on primary energy basis in oil equivalent term increases from 16 million kiloliters for lower price case to 20 million kiloliters for higher price case. The share of solar energy increases strikingly but once the break through happens photovoltaic power generation and fuel cell rapidly increase their share in the market. (37 figs, 82 tabs)

0208 Waste Management

REFER ALSO TO CITATION(S) 22417

21716 **(ALCRC—87-1) Disposal of drilling wastes.** Leskiw, L.A.; Reinl-Dwyer, E.; Dabrowski, T.L.; Rutherford, B.J.; Hamilton, H. (Alberta Land Conservation and Reclamation Council, Edmonton (Canada)). 1987. 233p. (MICROLOG—88-03650). Alberta Legislative Library, 216 Legislature Bldg., Edmonton, AB, Canada T5K 2B6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The objectives of this study were to identify problems associated with drilling waste disposal, to assess disposal criteria contained in existing Alberta guidelines, to develop, test, and demonstrate field application of a decision making flowchart, and to identify research needs and indicate mitigation measures for drilling waste disposal. Characteristics of commonly-used drilling wastes are identified, and the kinds of environments for disposal of such wastes in Alberta are outlined. The environmental effects of drilling waste disposal (on soils and plants, surface water, and groundwater) are summarized. Five provincial guidelines are examined, and their strong and weak points reviewed, with recommendations made to improve their effectiveness. The immediate practices to be considered for mitigating the effects of drilling waste disposal are proper sampling and analysis techniques, treatment of sumps where necessary, cleaner working conditions and conscientious handling of the sump fluids on lease, foresight and planning, and development of a waste management plan, particularly in areas of high drilling density. Appendices to this document include texts of the disposal guidelines, a glossary, and a field manual for sump location evaluation, surface waste disposal site evaluation, drilling waste characterization, and waste disposal. 177 refs., 6 figs., 24 tabs.

21717 **(JMF—8801) Maintenance manual of environmental pollution control equipment. Maintenance manual of exhaust gas denitrizer.** (Japan Society of Industrial Machinery Mfrs. (Japan)). Jun 1988. 108p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756845/JAW.

Performance and service life of environmental facilities remarkably vary according to operating conditions and maintenance of them and largely affect preservation of the environment. It is important for thoroughly utilizing the existing environmental pollution control facilities to possess a complete maintenance manual. In FY1987, the maintenance manual of an exhaust gas denitrizer was developed following those of anelectrostatic precipitator, awet type exhaust gas desulfurizer and a bag filter. The emission standards of nitrogen oxides, the trend of their protecting technology and the current status of exhaust gas denitrizer were presented, and the gist of operation and the main points of maintenance, inspection and management of selective catalytic reduction process, wet type denitrizing process and non-catalyst denitrizing process were described. An example of check sheet for routine inspection and that of check list for periodical inspection were presented. Most of thermal power plants use the selective catalytic reduction process to continue the stable operation. Typical examples of oil refinery, gas turbine plant and incinerator of municipal wastes were also presented. (49 figs, 23 tabs, 21 refs)

0220 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 22748

21718 **(ICE—8432E) Project Frigonav hovercraft type 140 operating experience, February-March 1987.** Jones, D. (Ice Control Enterprises, Inc., Hamilton, Ontario (Canada)). 1987. 40p. (MICROLOG—88-03196). Transport Canada, Library and Information Centre, Place de Ville, Tower C, Ottawa, Ont., Canada K1A 0N5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The area around Chicoutimi, Quebec is supplied with fuel from storage tanks normally supplied by ships coming up the Saguenay River. However, navigation is limited in winter when the river freezes, due to inability of icebreakers to navigate the shallow river, and fuel must be brought in by truck. A project was instigated to evaluate the possibility of clearing a channel between the oil pier and deep water by hovercraft, thereby providing a less costly alternative to moving fuel by road in the winter. An Airtrek 140 hovercraft, gross weight 7 tonnes, was chosen as a suitable machine for the task. Field trials were conducted to evaluate the performance of this craft at clearing the 30-70 cm ice along the navigation route. Some initial problems were encountered with the craft systems resulting from the extreme cold and contaminated fuel, but the overall test program was successful. A 300-m wide path 1.5 km long was cleared in 3 hours. A modified version of the craft, with additional power and ice impact protection, was recommended for future tests. 4 figs.

0230 Properties

21719 **(NP—9770303) Field ionisation and desorption mass spectrometry of saturated fractions of petroleum vacuum distillation residues.** Wolf, P.H. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Fakultaet fuer Bergbau, Huettenwesen und Maschinenwesen). 30 Jan 1987. 142p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE89770303/JAW.

The saturated parts of the short crude oil residue were analyzed with field ion mass spectrometry and field desorption mass spectrometry. The short residue for the analysis by means of mass spectrometry is preseparated in three ways: (a) molecular distillation and separation of the aromatics by liquid chromatography (LC); (b) precipitation by ethyl acetate, molecular distillation and separation of the aromatics by liquid chromatography; (c) precipitation with n-pentane, molecular distillation and separation of the aromatics by liquid chromatography. Field ion and field desorption

measurements carried out under optimum conditions show the following results: (a) for higher fractions, the relative numbers of rings shift towards larger numbers of rings. A comparison between field ionization and field desorption shows that field desorption is less suitable for quantitative analyses of mixtures. The number of rings are analyzed for the lighter fractions by means of field ionization. From this it follows: (b) the saturated parts of the short residue consist mainly of 5-ring systems, 4-ring systems and 6-ring systems. (c) 3-ring systems are notably under represented. There are several indications that greater ring systems with R>6 are contained in the heavier fractions.

0240 Storage

REFER ALSO TO CITATION(S) 22314

0250 Combustion

REFER ALSO TO CITATION(S) 21665, 22850

21720 **(NAL-TR—966) Spontaneous ignition of atomized kerosine/air mixtures in a high pressure flowing system.** Hayashi, Shigeru; Yamada, Hideshi; Shimodaira, Kazuo; Saito, Takashi; Horiuchi, Shoji. (National Aerospace Lab., Chofu, Tokyo (Japan)). Mar 1988. 11p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757174/JAW.

Simulating a premixing tube for the premixed/prevaporized type gas-turbine combuster, a spontaneous ignition tester with a venturi fuel injector has been developed. The apparatus was comprised of a preburner, a multi venturi fuel injector, a premixing tube, which was made of stainless steel with insulator at the outside of tube, of 45.3mm in inside-diameter and 200 mm in length, and an afterburner. Measurements of spontaneous ignition delay were conducted for mixtures of atomized kerosine and air at pressures from 1 MPa to 4 MPa, and equivalent ratios are 0.3 and 0.6. Ignition delay shortens as pressure increases up to 3 MPa. A further increase in pressure does not decrease ignition delay. For pressure up to 3MPa and inlet air temperatures from 680K to 810K, the empirical equation on ignition delay was derived. The variation of the equivalent ratio is found to have no appreciable effect on the measured ignition delay. The value of E which showes the intensity of temperature dependency for ignition delay is 92 kJ/mol, and that value is one half of the values previously reported for kerosine vapor/air mixtures. (9 figs, 1 tab, 15 refs)

03 NATURAL GAS

REFER ALSO TO CITATION(S) 22316

21721 **Development of an expert systems computer program for control panel design enhancement.** Franklin, A.L.; Pelto, P.J.; Fecht, B.A. (Energy Systems Dept., Battelle Northwest, Richland, WA (US)). pp v of Personal computer applications in the gas industry II. Bukacek, R.F. Chicago, IL; Institute of Gas Technology (1987). (CONF-870657—).

From 4. annual symposium on personal computer applications in the gas industry; Chicago, IL, USA (22 Jun 1987).

The control panel is the principal human/machine interface and is a key system in assuring the safe and reliable operation of a gas industry facility. The majority of gas industry facilities use hardwired control and display systems. Many newer facilities (and some existing facilities) are installing computer-aided control and display systems. In work conducted for the Gas Research Institute, Battelle Northwest has developed human factors guidelines for hardwired and computer-aided control and display systems. The guidelines themselves represent only a fraction of the total information gained during this research activity. Recent developments in the area of artificial intelligence provide a novel means for transferring and sharing expertise gained in developing these guidelines.

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 21696, 21698

0303 Drilling, Production, And Processing

21722 **(CONF-890411—1) Horizontal well coalbed methane production relative to face cleat orientation.** Soot, P.M. (Northwest Fuel Development, Inc., Portland, OR (USA)). 1989. Contract AC02-88ER80601. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008749/JAW.

From Coalbed methane symposium; University, AL, USA (17 Apr 1989).

Certain coals are structurally blocky and have well defined cleat systems. Based on experiences in underground mines which produce such coal, it has been noticed that more gas enters the mine when the entries are being developed perpendicular to the coal face cleats. Some research publications have extended this concept and concluded that horizontal wells drilled into the Pittsburgh Seam (a blocky coal) would be more productive if they are oriented perpendicular to the face cleat. The conclusions of those publications are not borne out by careful review of the data. 7 refs., 9 figs., 2 tabs.

0305 Health And Safety

21723 **(TC—TP1624) Report of an investigation into the circumstances attending the explosion on board the Canadian fishing vessel Bernic at Shelburne Harbour, Nova Scotia, March 24, 1987, with the subsequent death of one crew member and injuries to four other persons. Report no. 477.** (Transport Canada, Ottawa, Ontario. Research and Development). [1988]. 30p. (MICROLOG—87-04651). Transport Canada, Library and Information Centre, Place de Ville, Tower C, Ottawa, ON, Canada K1A 0N5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A fishing vessel experienced an explosion while docked at a wharf in Nova Scotia, during preparations for departure. This report describes the vessel and crew, the background to the explosion, and the causes and effects of the explosion. The vessel used a propane system for fuelling a water heater, stove, and refrigerator. It was concluded that propane had leaked out of the stove, which had apparently not been turned off when an empty propane cylinder had been changed for a fresh one. This leaked propane, being heavier than air, accumulated over a period of some 13 hours in the hold of the ship. It is thought that the propane ignited by an electric arc to the base of a light bulb as the bulb was being fitted into a receptacle. The subsequent explosion destroyed the vessel's accomodation section and wheelhouse and caused it to sink, becoming a total loss. A number of findings were made concerning propane safety. Regulations of the Canada Shipping Act that pertain to liquefied petroleum gas systems on ships are included in an appendix. 8 figs.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 21711

21724 **(CONF-8810108—1) Can a more competitive natural gas industry provide stability.** Hanson, D.A.; Jennings, T.V.; Lemon, J.R. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 13p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number TI89007506/JAW.

From 10. annual North American conference of the International Association for Energy Economics; Houston, TX, USA (30 Oct 1988).

This paper addresses the question, "Can a more competitive natural gas industry provide stability?" When we discuss a free gas market here, we are primarily referring to a market in which flexible, accurate prices are free to adjust to achieve market equilibrium

-- a balance of supply and demand. Implied is the lack of wellhead price regulations and the transmission of accurate price signals to both suppliers and end-users. Economic efficiency requires that prices respond to changes in conditions such as the world oil price, such as the world oil price, regional demands (for example, those of the Northeast US), sectoral demands (e.g., those of the electric utilities), and environmental policy (select use of gas for emission control, for example). 11 refs., 2 figs., 1 tab.

21725 **(GRI—9009147) 1988 GRI baseline projection of US energy supply and demand to 2010.** Holtberg, P.D.; Woods, T.J.; Ashby, A.B.; Lihn, M.L. (Gas Research Inst., Chicago, IL (USA). Strategic Analysis and Energy Forecasting Div.). Dec 1988. 96p. OSTI - Gas Research Institute, 8600 West Bryn Mawr Avenue, Chicago, IL 60631. Order Number TI89009147/JAW.

This report summarizes the 1988 GRI Baseline Projection of US Energy Supply and Demand, which has been adopted as a major input to the planning cycle leading to the development of Gas Research Institute's (GRI) 1990 research and development program. The baseline projection represents the GRI planning outlook for the economic and energy supply and demand situation to the year 2010. The 1988 projection was developed independently by GRI using publicly available data and a framework of commercially available models that GRI has modified over several years. It is not derived from the views of GRI member companies. 2 figs., 20 tabs.

21726 **A comparative life-cycle costing spreadsheet for assessing prime movers in variable-load industrial applications.** Chockie, A.D. (Battelle, Pacific Northwest Labs., Richland, WA (US)). pp v of Personal computer applications in the gas industry II. Bukacek, R.F. Chicago, IL; Institute of Gas Technology (1987). (CONF-870657—).

From 4. annual symposium on personal computer applications in the gas industry; Chicago, IL, USA (22 Jun 1987).

In recent years there has been an increasing interest and growing market in the use of electric motors with variable-speed control for varying load industrial applications. A substantial amount of energy can be saved in operating rotating equipment such as pumps and blowers when the power source has variable-speed control. Gas prime movers, in addition to having variable-speed capability, also have the inherent capability of providing exhaust or waste heat that can be used in certain process applications. Battelle, Pacific Northwest Laboratories recently developed a unique spreadsheet for analyzing life-cycle costs to provide a cost comparison between natural-gas-fired prime movers and electric motors in variable-load industrial applications. This spreadsheet, developed as part of a Gas Research Institute sponsored study, combines cost and technical performance information with operating load characteristics into a clear and concise format for use on a personal computer. The relative importance of each cost component for different prime movers and for different operating load scenarios can easily be assessed using the spreadsheet. The spreadsheet model provides detailed performance and cost information tables along with graphs and tables displaying the comparative analysis results.

0307 Waste Management

REFER ALSO TO CITATION(S) 21716

0308 Environmental Aspects

21727 **(GRI—88/0318) Erosion control on a steeply sloped pipeline right-of-way in southwestern Pennsylvania: Final report, June 1984--April 1988.** Zellmer, S.D.; Taylor, J.D. (Gas Research Inst., Chicago, IL (USA); Argonne National Lab., IL (USA)). Oct 1988. Contract W-31109-ENG-38. 64p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008757/JAW.

Soil erosion by precipitation on steeply sloped pipeline rights-of-way (ROWs) in the period between ROW rehabilitation and development of a dense, self-sustaining vegetative ground cover can cause locally severe soil losses, elevated sediments loads in receiving streams, and increase difficulty and cost of ROW maintenance. This field study, funded by the Gas Research Institute and conducted by Argonne National Laboratory, compared the environmental effectiveness of nine treatments (six methods and three controls) on a 23% ROW slope in southwestern Pennsylvania. Replicated plots were established, immediately after ROW cleanup, over the pipeline and on the working side of the ROW. The six prevegetation methods represented a wide range of material and installation costs. Precipitation, runoff volumes, and sediment yields were measured at each of 51 plots for 45 precipitation events during the 18-month study. Vegetation data were collected by the point-intercept method four times during the study to determine the amount of plant cover and species composition. Differences in sediment yield were observed among methods and between ROW locations, but plant cover development was not influenced by method or location. The relationship between environmental and cost data indicated that, of the six erosion control methods tested, straw mulch applied at the rate of 3.35 metric tons per hectare (1.5 tons/acre) was the most effective. 38 refs., 6 figs., 14 tabs.

0309 Artificial Stimulation

21728 **(DOE/FE—0122) Unconventional gas recovery program plan, FY 1988.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of the Deputy Assistant Secretary for Oil, Gas, Shale and Special Technologies). Jun 1988. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008951/JAW.

Unconventional gas recovery (UGR) includes the development of advanced technologies for the extraction of natural gas from currently unrecoverable gas resources. The resources for UGR include lenticular tight gas sands, eastern Devonian shales, gas hydrates, deep source gas, gas-to-liquids and coalbed methane. This report includes a technology description, program goals, planning and management discussion. 11 refs., 4 figs., 2 tabs.

21729 **Fracture mechanics applications in rock mechanics problems.** Chen, E.P. (Applied Mechanics Div. 1522, Sandia National Labs., Albuquerque, NM (US)). pp v of Proceedings of ICF international symposium on fracture mechanics. Utrecht, Netherlands; VNU Science Press (1984). (CONF-831101—).

From International symposium on fracture mechanics; Beijing, China (22 Nov 1983).

The application of fracture mechanics principles to the solution of rock mechanics problems is the subject of discussion in this paper. Specifically, two examples relating to high energy gas fracturing and oil shale blasting are presented to illustrate the point. In high energy gas fracturing experiments, the way in which elastodynamic fracture mechanics can be used to design the pressure pulse shapes for multiple fracturing around the wellbore is given. In oil shale blasting, the strain rate effect can explicitly be treated in terms of fracture mechanics parameters. This treatment proves to be essential in the development of a damage model which has been used successfully in the evaluation of in situ oil shale retort blast designs.

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 21723

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 21725, 22748, 23892

0340 Combustion

REFER ALSO TO CITATION(S) 21665, 22850

04 OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 22316

21730 **(DOE/FE—0119) Oil shale program plan, FY 1988.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of the Deputy Assistant Secretary for Oil, Gas, Shale and Special Technologies). Jun 1988. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008948/JAW.

The oil shale program is directed to the development of advanced technologies for extracting shale oil from the large domestic resources. The overall goal is to foster development of an economically competitive and environmentally acceptable oil shale industry. A series of technology development steps must be taken by DOE, other government agencies and other governments and/or industry to achieve this goal. They include basic and applied R and D, proof-of-concept activities, first-of-a-kind field tests and associated commercial-scale activity. Technology status, research needs, program goals and program management of oil shales are addressed. 8 refs., 1 fig., 1 tab.

21731 **(DOE/FE—0121) Tar sands program plan, FY 1988.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of the Deputy Assistant Secretary for Oil, Gas, Shale and Special Technologies). Jun 1988. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008946/JAW.

The tar sands program is directed toward expanding the technical information base needed to develop advanced technologies for recovering oil from large, presently unrecoverable resources. The overall goal of the program is to foster industry development of economically competitive and environmentally acceptable recovery processes. Many technology barriers substantially limit development of the nation's tar sands resources to a small fraction of their potential as a source of petroleum liquids. Recovery process parameters are not fully understood; the amenability of deposits of varying chemical/physical makeup to different recovery process approaches needs further evaluation; and the expected variability of process cost factors, including the desirability of recovered products and the costs of mitigating process waste pollutants, requires research and assessment. The Department of Energy's (DOE's) technical objectives for the tar sands program relate to the research needs associated with specific functional and process information needs. These objectives are presented. 3 refs.

0401 Reserves And Exploration

REFER ALSO TO CITATION(S) 21692

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 21729

21732 **(DOE/METC—88/6098) Proceedings of the third annual oil shale, tar sand, and mild gasification contractors review meeting.** Bartke, T.C. (ed.). (USDOE Morgantown Energy Technology Center, WV). Dec 1988. 488p. (CONF-880725—7). NTIS, PC A21/MF A01 - OSTI; 1; GPO Dep. Order Number DE88010257/JAW.

From 3 annual oil shale, tar sand, and mild gasification contractors review meeting; Morgantown, WV, USA (19 Jul 1988).

The purposes of this meeting were to review the current status and recent accomplishments in oil shale, tar sand and mild gasification of coal, to encourage interchange of ideas and information, and to enable the Department of Energy to plan for future work. The meeting provided a forum for the direct interaction of industry and the Department of Energy to ensure that the research and development efforts be beneficial to all interested parties. Individual projects are processed separately for the data bases.

21733 **(UCID—16986-88-4) Lawrence Livermore National Laboratory oil shale quarterly report, October--December 1988.** Cena, R. (ed.). (Lawrence Livermore National Lab., CA (USA)). Mar 1989. Contract W-7405-ENG-48. 16p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009008/JAW.

Research on the following topics is briefly described: flash pyrolysis of devonian oil shale - the role of dust; the impact of burnt shale on yield of eastern oil shale; and is it feasible to use carbonates to control sulfur dioxide emissions during the combustion of retorted eastern oil shale? A list of fossil energy publications for 1988 is included. 6 figs., 2 tabs.

21734 **(WU/RI—1987) Evaluation of atmospheric flash pyrolysis for copressing residue.** (Waterloo Univ., Ontario (Canada). Research Inst.). 1987. 270p. (MICROLOG—88-03904). Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, Ont., Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A series of pyrolysis tests were carried out on a Saskatchewan lignite, using a small pilot plant unit. In addition, coal/bitumen coprocessing residues (or other feedstocks used for simulating such residues) were tested in a bench-scale continuous fluid bed unit. Objectives of the lignite tests were to establish optimum processing conditions, assess liquid product quality, and determine if quality could be affected by use of a catalyst in the fluid bed. A major objective of the tests on the coprocessing residue was to assess whether a reasonable yield of fluid oil was obtainable, together with a dry coke of acceptable properties. It was found that good yields of tars high in phenolic compounds could be obtained from pyrolysis of lignites. Yields are enhanced by moisture contents up to 22%; increased benzene-toluene-xylene yields appear possible using a hydrogen atmosphere and suitable catalyst. Acid washing of lignite increases the tar yield. Pyrolysis of the residues indicated difficulties due to formation of strong and highly adherent coke. In the fluid bed, pyrolysis at 700/sup 0/C yielded about 50% liquid hydrocarbon, 44% char and 6% gas. Better performance and longer runs resulted when using a modified spouted bed reactor, but agglomeration problems still occurred and data were inconsistent. Atmospheric flash pyrolysis was thus shown to be capable of giving good liquid yields from coprocessing residue, but design of a suitable reactor that could meet industrial-scale requirements was not possible without further research. 27 refs., 62 figs., 48 tabs.

0405 Properties And Composition

21735 **(UCID—21665) A simple kinetic model of petroleum formation and cracking.** Burnham, A.K. (Lawrence Livermore National Lab., CA (USA)). Mar 1989. Contract W-7405-ENG-48. 14p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008652/JAW.

A simple chemical kinetic model of petroleum formation and maturation is presented. Kerogen decomposes to coke-prone labile oil, gas-prone refractory oil gas, and refractory kerogen. The kinetics and stoichiometry of this reaction depend on kerogen type. Labile and refractory oil decompose further with continued heating to gas and refractory kerogen. Refractory kerogen also releases methane with continued heating. The model accounts to some extent for the difference in chemical composition between natural petroleum and laboratory pyrolysates. The model is compared with other simple and more complex models. 13 refs., 4 figs., 3 tabs.

05 NUCLEAR FUELS

0501 Reserves, Exploration, And Mining

REFER ALSO TO CITATION(S) 21756

21736 **(IAEA-TECDOC—484) User's guide for the Uranium Ore Reserve Calculation System (URAD).** (International Atomic Energy Agency, Vienna (Austria)). Dec 1988. 214p. NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS. Order Number DE88705644/JAW.

The URAD (Uranium Reserves and Data) system consists of four computer programs designed to facilitate the evaluation of uranium ore reserves analysis and the handling of basic uranium assay data. URAD is designed specifically as a training tool for anyone unfamiliar with the methodology, data requirements, and/or general computer applications in the field of uranium ore reserves analysis. However, it can effectively be used in a 'production' environment involving considerable amounts of data. The resulting programs are written in Microsoft FORTRAN (Version 3.1) and may be run on any IBM-compatible microcomputer under DOS 2.1 (or later). Only a basic working knowledge of DOS 2.1 is needed to maintain the system and run the programs. This guide includes the overview of the URAD system, the review of sample data and a complete description of the file structure and sample type formats of the basic sample data files. Program URDAT explains the initial processing of the primary UDAT files to obtain standard output listings and gamma-log interpretations of radiometric data, and to create intermediate UDAT files which are used by the ore reserves programs - RESUV, ORSAC, and SCOR. Figs and tabs.

0505 Uranium Enrichment

21737 **(INIS-mf—11920) Process engineering investigations conducted as part of the joint research project 'Engineering fundamentals of uranium enrichment using laser techniques'. Final report.** Gregorius, K.; Kokemueller, D.; Schoerner, H.; Vollmar, H. (Kraftwerk Union A.G., Erlangen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jul 1988. 47p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757368/JAW.

Investigations focused on process engineering questions. The following three topics were dealt with: 1. Development of suitable nozzles for adiabatic cooling. Sonic nozzles, supersonic nozzles and nozzle systems were investigated for adaptation to this process. The influence of nozzle geometry, carrier gas, mixture ratio, stagnation pressure and temperature, and also the expansion ratio on relevant process parameters was investigated. 2. Separation of produced UF/sub 5/ from the gas stream containing UF/sub 6/. The separation of monomerous UF/sub 5/ by a metallic grid immediately downstream of the irradiation zone as well as the separation of UF/sub 5/-particles by an inhomogeneous electric field was experimentally investigated. Supplementary the growing of UF/sub 5/-particles in the gas stream was measured and the possibility of collecting UF/sub 5/-particles by a cyclone was estimated. 3. Investigations on laser beam path manipulation. A computer program was used to investigate the effects of density gradients on deflection of and energy distribution in the laser beam for experimentally-determined UF/sub 6/ density fields. (orig./HP) With 1 ref., 3 tabs., 16 figs.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 22054, 22096, 22126, 22130, 22551, 23048

21738 **(CONF-890370—1) The determination of UO_2 and UF_4 in fused fluoride salts.** Batiste, D.J.; Lee, D.A. (Oak Ridge National Lab., TN (USA); Oak Ridge Y-12 Plant, TN (USA)). 1989. Contract AC05-84OR21400;AC05-84OS21400. 13p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007849/JAW.

From 16. annual meeting of the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers; Chicago, IL, USA (20 Mar 1989).

The determination of uranium oxide solubilities in fused fluoride salts is important in the electrolytic preparation of uranium metal. This project was initiated to develop a method for the determination of UO_2 separately from UF_4 in UF_4-CaF_2-LiF fused salts. Previous methods used for the determination of UO_2 in fused fluoride salts involved inert gas fusions where oxygen was liberated as CO_2, and hydrofluorination where oxygen was released as H_2O; but the special equipment used for these procedures was no longer available. These methods assumed that all of the oxygen liberated was due to UO_2 and does not consider impurities from reagents and other oxygen sources that amount to a bias of approximately 0.3 wt %. This titrimetric method eliminates the bias by selectively extracting the UF_4 with a Na_2EDTA-H_3BO_3 solution. The remaining uranium oxide residue is treated and titrated gravimetrically to a potentiometric endpoint with NBS standard $K_2Cr_2O_7$. An aliquot of the Na_2EDTA-H_3BO_3 extract is also titrated gravimetrically to a potentiometric endpoint, this uranium component is determined and calculated as UF_4. 4 refs., 2 figs., 2 tabs.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 21790, 21838, 21850

21739 **(BARC—1422) Continuous process for precipitation of ammonium diuranate from uranyl solution: Part 1.** Siddiqui, I.A.; Shah, B.V.; Tadphale, S.H.; Kumar, S.V. (Bhabha Atomic Research Centre, Bombay (India). Process Engineering and Systems Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1988. 21p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706138/JAW.

The development of a continuous reactor system for conversion of uranium from the Purex tail-end to yellow cake using commercial ammonia gas is discussed. Precipitation of uranium is carried out as a continuous process in a compactly designed reactor. The reactants are agitated by air passed into the reactor. The pH of the product overflow is measured in-line and is maintained at the desired value by automatic control of the flowrate of ammonia gas. The design parameters are enumerated and selection of some parameters is discussed. The reactor system and the associated instrumentation are described in detail. The reactor is capable of handling uranyl nitrate feed over a wide range of acidity, uranium content and feed flowrates without difficulty and loss of material. The pilot plant reactor of 22 lit active volume is capable of processing 10 to 12 kg uranium per hour. The system has been designed to operate reliably and efficiently with minimum necessity of operator-intervention. Suitable conditions to avoid troubles due to heavy slurries resulting from concentrated feed and low flow velocity have been identified. (author). 6 figs., 2 tables.

21740 **(CEA-tr—2313) Reprocessing spent nuclear fuels by dissolution.** Hirose, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Feb 1988. 16p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757191/JAW.

During dissolution of spent fuels by nitric acid, palladium and iodine (fission products) are precipitated under the form of palladium iodide by maintaining the temperature below decomposition of palladium iodide (105/sup 0/C).

21741 **(JAERI-M—88-209) Development of tritium scrubbing technology for tritiated water recycle process, (I). Mock-up test of mixer-settler with internal recycle for tritium scrubber.** Sugikawa, Susumu; Fujine, Sachio; Maeda, Mitsuru; Tsujino, Takeshi; Ai, Hironobu; Ohtou, Yoshihiro; Suyama, Naohiro. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Oct 1988. 33p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757250/JAW.

In order to improve tritium management in fuel reprocessing, the tritiated water recycle process has been studied. The process requires the development of a contactor which allows efficient scrub of tritium in organic solvent with a small volume of non-tritiated scrub-solution. A mock-up experiment was carried out for

the development of a mixer-settler type tritium scrubber in an engineering scale, using a single-stage and two-stage plexiglass mixer-settlers. A mixer-settler type contactor with internal recycle, which allows efficient mixing under the condition of high organic to aqueous flow ratio, was developed and key design conditions were established.

21742 **(LA—11479) Separation of thorium impurity from plutonium in the nitrate anion exchange process.** Marsh, S.F.; Phillips, B.J.; Aldaz, E.A.; Williams, W.E. (Los Alamos National Lab., NM (USA)). Apr 1989. Contract W-7405-ENG-36. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008956/JAW.

Thorium is a common impurity in many materials processed at the Los Alamos Plutonium Facility. Although the thorium impurity level is usually less than 1000 ppM, it frequently exceeds the maximum allowable limit of 100 ppM. Thorium is especially difficult to separate from plutonium because it accompanies plutonium in the three aqueous nitrate processes used at Los Alamos: nitrate anion exchange, oxalate precipitation, and peroxide precipitation. Nitrate anion exchange, the major aqueous plutonium purification process, has recently been modified to remove most of the thorium from sorbed plutonium by washing the column with 4.7 M nitric acid-0.007 M hydrofluoric acid. This chromatographic washing technique requires careful process control that is readily attainable with the recently developed Los Alamos On-Line Gamma Monitor. The successful separation of thorium using this modification has been demonstrated in routine, full-scale, nitrate anion exchange operations. 3 refs., 8 figs.

21743 **(NUKEM-FuE—87046) Pulsed column improvement - study (phase 1). Final report.** Demmich, J.; Kios, S.; Christophersen, H.W.; Huschka, H. (Nuklear-Chemie und - Metallurgie G.m.b.H. (NUKEM), Hanau (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). May 1988. 85p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757377/JAW.

The study deals with a special aspect of solvent extraction using pulsed sieve-tray columns, especially for the reprocessing of fast breeder reactor fuel. On the basis of studies carried out in the last few years by university and other research institutes, the study in hand concentrates on aspects of process engineering and equipment design likely to bring about improvements for current approaches and concepts. There are two main results explained in this study. The first refers to the extraction column itself, which is characterised by heterogenous poisening and a modified geometry, and the second refers to the process (comparison of aqueous continuous process and organic continuous process). The report explains the design of an improved pulsed column for the aqueous, continuous route of reprocessing and the relevant flow-sheet of a test stand.

21744 **(RFP—4204) Production-scale Direct Oxide Reduction demonstration.** Humiston, T.J.; Santi, D.J.; Long, J.L.; Thomas, R.L. (ed.); Delaney, I.C. (comp.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 23 Jan 1989. Contract AC04-76DP03533. 18p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008932/JAW.

A detailed, statistically valid, examination of the direct oxide reduction parameters affecting process yield and purity was planned and executed. Guidelines for attaining yields approaching 100% are presented. Feed oxide, percent excess calcium, and stirrer design affected yield and product purity. Experiments were performed in production-scale equipment utilizing 800 grams of plutonium dioxide per charge. 1 ref., 9 figs., 3 tabs.

21745 **(UCID—21542-88-3) Plutonium residue recovery (PuRR) project: Quarterly progress report, October--December 1988.** Alire, R.M.; Coops, M.S.; Gregg, D.W.; Hickman, R.G.; Landrum, J.H.; Pittenger, L.C.; Johnson, G.K.; Johnson, I.; Mulcahey, T.P.; Piece, R.D. (Lawrence Livermore National Lab., CA (USA)). Feb 1989. Contract W-7405-ENG-48. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009061/JAW.

Substantial progress was made in several areas of the PuRR (plutonium residue recovery) program during the quarter. Criteria were developed for selecting process options, with the goal of process simplification. A modified flowsheet and material balance were selected that reflect these priorities. Efforts to effect a front-end separation by sedimentation were not successful. Experimental liquid-liquid extractions from alloys to salts based on valence change were performed. Results ranged from fair to good, but experimental equipment materials problems occurred. Also, substantial interference from the large excess of tramp metals present, which influence plutonium activity, suggested alternate approaches should be given priority. Estimates of the high-temperature thermodynamic functions of americium chlorides were calculated for the first time. 11 refs., 3 figs., 10 tabs.

21746 **Modeling risk assessment for nuclear processing plants with LAVA.** Smith, S.T.; Tisinger, R.M. (Safeguards Systems Group, MS-E541, Los Alamos National Lab., Los Alamos, NM (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 101-104(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Using the Los Alamos Vulnerability and Risk Assessment (LAVA) methodology, the authors developed a model for assessing risks associated with nuclear processing plants. LAVA is a three-part systematic approach to risk assessment. The first part is the mathematical methodology; the second is the general personal computer-based software engine; and the third is the application itself. The methodology provides a framework for creating applications for the software engine to operate upon; all application-specific information is data. Using LAVA, the authors build knowledge-based expert systems to assess risks in applications systems comprising a subject system and a safeguards system. The subject system model is sets of threats, assets, and undesirable outcomes. The safeguards system model is sets of safeguards functions for protecting the assets from the threats by preventing or ameliorating the undesirable outcomes, sets of safeguards subfunctions whose performance determine whether the function is adequate and complete, and sets of issues, appearing as interactive questionnaires, whose measures (in both monetary and linguistic terms) define both the weaknesses in the safeguards system and the potential costs of an undesirable outcome occurring.

21747 **Cyclic voltametric study of the reduction of Pu(III) to plutonium metal in molten LiCl-NaCl-CaCl/sub 2/-BaCl/sub 2/-PuCl/sub 3/.** Poa, D.S.; Tomczuk, Z.; Steuenberg, R.K. (Chemical Technology Div., Argonne National Lab., Argonne, IL (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

Cyclic voltammetry was used to investigate the electrochemistry of the reduction of PuCl/sub 3/ to plutonium metal in molten LiCl-NaCl-CaCl/sub 2/-BaCl/sub 2/ containing dissolved PuCl/sub 3/. The purpose of the study was to determine the kinetics of the reaction. This information will then be used in helping design electro-refining equipment for the reprocessing of core and blanket fuel discharged from the Integral Fast Reactor (IFR).

0509 Transport And Storage

REFER ALSO TO CITATION(S) 21828, 21838, 21874, 23692

21748 **(AEEW-M—2516) Application of shielding and criticality methods to fuel transport operations.** Avery, A.F.; Ingram, G.; Knipe, A.D.; Locke, H.F. (UKAEA Atomic Energy Establishment, Winfrith (UK). Reactor Physics Div.). May 1988. 20p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705945/JAW.

Shielding and criticality safety are important considerations in the operations associated with the transportation of reactor fuel. The applicability of standard calculational methods and data to fuel transport situations are being studied at Winfrith. Transport flask shielding calculations, performed to predict external dose-rates from both gamma-rays generated by the decay of fission products and

neutrons emitted by actinides, frequently use multigroup methods. However, problems associated with multigroup calculations can result in significant errors. An approach using point energy data has been developed to avoid these difficulties and is described in the first part of the report. The validity of the methods used for criticality assessments are being examined in a major experimental programme in the DIMPLE facility at Winfrith. A large number of precisely defined fuel pin lattices are being studied, ranging from simple cylindrical geometry benchmarks to complex simulations of transport flask geometries. Experimental results, and comparisons with predictions from the standard criticality codes used in the UK, are provided in the second part of the report.

21749 **(CEA-DAS—554) Toxic and radiological risk equivalence approach in UF6 transport.** Ringot, C.; Hamard, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Dec 1988. 9p. (CONF-880558—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757346/JAW.

From Uranium hexafluoride--safe handling, processing, and transporting conference; Oak Ridge, TN, USA (24 May 1988).

After a brief description of the safety in transport of UF/sub 6/, we discuss the equivalence of the radioactive and chemical risks in UF/sub 6/ transport regulations. As the concept of low specific activity appears to be ill-suited for a toxic gas, we propose a quantity of material limit designated T/sub 2/ (equivalent to A/sub 2/ for radioactive substances) for packagings unable to withstand accident conditions (9 m drop, 800/sup 0/C fire environment for 30 minutes). It is proposed that this limit be chosen for the amount of release acceptable after AIEA tests. Different possible scenarios are described, with fire assumed to be the most severe toxic risk situation.

21750 **(EGG-WM—8059) Dry Rod Consolidation Technology Project at the Idaho National Engineering Laboratory.** Vinjamuri, K.; Feldman, E.M.; Mullen, C.K.; Griebenow, B.L.; Arave, A.E.; Hill, R.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1988. Contract AC07-76ID01570. 289p. NTIS, PC A13/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009723/JAW.

This report presents the results and findings of the Dry Rod Consolidation Technology (DRCT) Project performed at the Idaho National Engineering Laboratory for the US Department of Energy (DOE) by EG&G Idaho, Inc. The objectives of the DRCT Project have been (1) to demonstrate dry rod consolidation of pressurized water reactor (PWR) fuel assemblies having a Westinghouse 15 {times} 15 array design and (2) to develop and document the technology associated with the dry consolidation process. These program objectives were accomplished. A consolidation ratio of 2 to 1 for the fuel rods from the PWR fuel assemblies was achieved. The fuel rods from 48 fuel assemblies were consolidated into 24 consolidation canisters, each having the same outside dimensions as that of the original 15 {times} 15 array PWR fuel assembly. Equipment for dry horizontal consolidation was designed, operational experience was gained, and process technical information was obtained. All relevant aspects of information from the Project are being made available to the Prototypical Consolidation Demonstration Project and the Nonfuel Bearing Component Volume Reduction Project. The information will also be used by DOE to increase the data base for future planning and design of production-scale fuel rod consolidation equipment. 11 refs., 96 figs.

21751 **(KAERI/RR—536/86) Study on the management of radioisotope wastes.** Kim, Gil Jung; Park, Hun Hwee; Kim, Chong Hyun; Lee, Jae Won; Hwang, Tae Won; Lee, Byung Jik; Ju, June Sik. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Dec 1986. 106p. (In Korean). NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88705846/JAW.

The purpose of this study is to aid the polish of radwaste treatment expecting nuclear power plant. The amount of annual radwaste generation from the institutional use of radioisotopes is predicted based on the estimation of radioisotope imports that is made in the present study for 1985-1986 in collaboration with Korea Radioisotope Association Inc. In order to survey and to realize the current status of the radioactive waste management, we visited organizations using radioisotopes, i.e. medical institutions, colleges, research institutes and industries. It was revealed as a result that there was no unified treatment process and the radioactive waste management in those institutions has been rather expedient. The management of radioactive waste from RI application is controlled by the Atomic Energy Low. However, the procedures of handling and treatment suggested and the technological difficulties make it hard to conform with. Accordingly, a guide for the safe handling and treatment of radioactive waste(draft) is prepared to enhance the safety during the use of radioisotopes and in the management of waste generated from their application. The radioactive waste containers for the collation and interim storage and their materials should be specified and standardized according to the type and characteristics of radioacive waste. In the present study, several specific containers are selected and suggested for use. However, their performance should be tested later on.

21752 **(KAERI/RR—572/86) Development of spent fuel transportation equipment.** Kwack, Eun Ho; Kang, Hee Young; Lee, Chung Young; Lee, Heung Young; Jeon, Kyeng Lak; Lee, Jae Han; Lee, Hyung Yeon. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Apr 1987. 307p. (In Korean). NTIS (US Sales Only), PC A14/MF A01 - OSTI; INIS. Order Number DE88705865/JAW.

The spent fuel transportation equipment which should be equipped with the KSC-1 cask at Kori nuclear power plant site was developed. It comprises a cask lifting devices, a lifting device supporter, cask closure handling tools, a scaffolding structure, a cask supporter, trailer and the auxiliary devices. Their high reliability in design and fabrication was ensured with quality assurance program and performance tests according to ANSI NI4.6-1978.

21753 **(NUKEM-FuE—88028) Analysis of principle possibilities of intermediare storage of fast breeder reactor fuel elements. Final report.** Schoenfeld, R.; Dries, G.; Pade, D. (Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Hanau (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jan 1989. 52p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88757380/JAW.

The principle possibilities of intermediate storage of fast breeder reactor fuel elements were analyzed and compared on the basis of 4 different concepts of storage. The SNR-2 fuel element was chosen as reference. Only the pool (wet) storage could be used to store fuel elements of less than 18 months precooling time. The other concepts (dry storage and container storage) have distinct advantages at precooling times longer than 18 months. (orig./HP) With 22 tabs., 8 figs.

21754 **(NUREG/CR—4554) SCANS (Shipping Cask ANalysis System) a microcomputer based analysis system for shipping cask design review: Volume 4--Theory manual: Thermal analysis.** Johnson, G.L.; Shapiro, A.B. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Lawrence Livermore National Lab., CA (USA)). Feb 1989. Contract W-7405-ENG-48. 67p. (UCID—20674-Vol.4). NTIS, PC A04/MF A01 - GPO - OSTI. Order Number TI89009301/JAW.

TOPAZ is the two-dimensional, implicit, finite-element computer code included in the SCANS cask analysis system for heat conduction calculations. TOPAZ, a code developed on LLNL mainframes, has been implemented on IBM PC computers. This report provides documentation of TOPAZ controls and variables and a description of the numerical algorithms used. Sample problems with analytical solutions are presented. 10 refs., 32 figs., 11 tabs.

21755 **(NUREG/CR—4554-Vol.3) SCANS (Shipping Cask ANalysis System) a microcomputer based analysis system for shipping cask design review: Volume 3--Theory manual: Lead slump in impact analysis and vertification of impact analysis.** Chun, R.C.; Lo, T.; Mok, G.C.; Witte, M.C. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards and Transportation; Lawrence Livermore National Lab., CA (USA)). Feb 1989. Contract W-7405-ENG-48. 94p. (UCID—20674-Vol.3). NTIS, PC A05/MF A01 - GPO - OSTI. Order Number TI89009300/JAW.

A computer system called SCANS (Shipping Cask ANalysis System) has been developed for the staff of the US Nuclear Regulatory Commission to perform confirmatory licensing review analyses. The SCANS can handle problems associated with impact, heat transfer, thermal stress, and pressure. A new methodology is developed for SCANS to analyze the lead slump behavior of lead-shielded casks during a postulated impact with an unyielding surface. The methodology is an expansion of the existing lumped-parameter impact analysis method. It is assumed that the lead and the steel cylinders are not bonded as opposed to the existing bonded-lead assumption. The lead and the steel cylinders are treated as an elastic medium and thin elastic shells, respectively. The shielding reduction, or the permanent lead slump at the opposite end of impact, is obtained by converting the elastic strain energy of the lead into plastic deformation. The interface pressure between the lead and the steel, the hoop stress in the steel shells, and the reduction in shielding are among items that can be calculated. The adequacy of this lead slump methodology is established by comparing results with those obtained from rigorous finite element analyses and from cask impact tests. 9 refs., 13 figs., 8 tabs.

0510 Marketing, Economics, And By-products

21756 **(INIS-XN—173) Uranium Resources, production and demand. Statistical update 1988.** (Nuclear Energy Agency, 75 - Paris (France)). 1988. 10p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705773/JAW.

Also published in French.

Periodic assessments of world uranium supply and demand have been conducted by the OECD Nuclear Energy Agency (NEA) and the International Atomic Energy Agency (IAEA) since the mid 1960s. Published every two years, the report URANIUM RESOURCES, PRODUCTION AND DEMAND, commonly referred to as the RED BOOK, has become an essential reference document for nuclear planners and policy makers in the international nuclear community. The latest Red Book, published in 1988, was based on data collected mainly in early 1987. Most of the data for 1987 were therefore provisional. The STATISTICAL UPDATE 1988 provides updated 1987 data collected in 1988 and provisional data for 1988. The publication, which covers OECD Countries and gives Secretariat estimates for the rest of the World Outside Centrally Planned Economies (WOCA), is being issued every second year, between publications of more complete Red Books.

0520 Waste Management

REFER ALSO TO CITATION(S) 21745, 21751, 21837, 21881, 22013, 22023, 22024, 22035, 22046, 22056, 22058, 22069, 22071, 22310, 22660, 22732, 22740, 22851, 23106, 23107, 23186

21757 **(AECL—9620) Processing of LLRW arising from AECL nuclear research centers.** Buckley, L.P.; Le, V.T.; Beamer, N.V.; Brown, W.P.; Helbrecht, R.A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nov 1988. 20p. (CONF-880662—1). Atomic Energy of Canada Limited, Chalk River, Ontario, Canada KOJ1J0.

From 28. annual conference of the Canadian Nuclear Association and the 9th annual conference of the Canadian Nuclear Society; Winnipeg, Canada (12 Jun 1988).

Operation of nuclear research reactors and laboratories results in the generation of a wide variety of solid and liquid radioactive wastes. This paper describes practical experience with processing of low-level radioactive wastes at two major nuclear research centers in Canada. 17 refs., 3 figs., 4 tabs.

21758 **(AECL—9830) Design, development and safety assessment of the IRUS [intrusion resistant underground structure] repository for disposal of low-level radioactive waste.** Hardy, D.G.; Philipose, K.E.; Jarvis, R.G. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nov 1988. 11p. (CONF-880903—48). Atomic Energy of Canada Limited, Chalk River, Ontario, Canada KOJ1J0.

From Spectrum '88: international topical meeting on nuclear and hazardous waste management; Pasco, WA, USA (11 Sep 1988).

A description is provided of IRUS (Intrusion Resistant Underground Structure), a belowground vault intended for LLRW with a hazardous lifetime of 500 years, and scheduled to start accepting wastes in 1991. The R&D programs in support of IRUS are concentrating on the optimization of barrier materials, such as concrete and buffer layers, and on understanding the chemistry and physics of the processing occurring within the vault. Safety assessments using the COSMOS S/D code have shown that the risks to the critical population from IRUS are well within regulatory limits.

21759 **(AEEW-M—2239) Proposed development programme for a temporary containment system for alpha active decommissioning.** Pengelly, M.G.A.; Burnett, R.C. (UKAEA Atomic Energy Establishment, Winfrith (UK). Materials Technology Div.). Jun 1983. 14p. (PCMRP—83-14). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705607/JAW.

This report makes a proposal to design, develop and test a containment of modular construction under plutonium active conditions. While this proposal contemplates work with plutonium, the system, when fully developed, has obvious applications wherever a temporary containment of radioactive or toxic materials is required. The fundamental feature of the proposal is that strippable coatings are used to prevent the inner surfaces of the working area from becoming contaminated. It is envisaged that this method of protecting the surfaces will enable the modular containment structure to be disassembled and re-used.

21760 **(BNL—41456) Application of an allocation methodology.** Youngblood, R.; de Oliveira, L.F.S. (Brookhaven National Lab., Upton, NY (USA)). 1989. Contract AC02-76CH00016. 8p. (CONF-890405—25). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009366/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

This paper presents a method for allocating resources to elements of a system for the purpose of achieving prescribed levels of defense-in-depth at minimal cost. The method makes extensive use of logic modelling. An analysis of a simplified high-level waste repository is used as an illustrative application of the method. It is shown that it is possible to allocate quality control costs (or demonstrated performance) in an optimal way over elements of a conceptual design. 6 refs., 3 figs., 2 tabs.

21761 **(CEA-tr—2249) Fabrication process of blocks of radioactive wastes encapsulated in cement and resistant to leaching and salt solutions.** Holtz, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Oct 1987. 7p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757185/JAW.

Waterproof additives are claimed to decrease water penetration through the cement such as silicone resins, latex emulsions or organic aluminium salts, avoiding leaching of radioactive wastes.

21762 **(CEA-tr—2301) Abrasive particles for blasting.** Toshima, T.; Miyazaki, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Dec 1987. 6p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757188/JAW.

Decontamination of radioactive parts is claimed by blasting solid carbon dioxide or ice particles incorporating fine abrasives, production of secondary waste is decreased.

21763 **(CEA-tr—2303) Process for removal of surface contamination from nuclear reactor components.** Yoshikawa, K. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Dec 1987. 5p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757189/JAW.

Surface contamination is removed by ice blasting using hardened ice or solid carbon dioxide at a great speed in pressurized fluid through a nozzle.

21764 **(CEA-tr—2308) Microwave melting of ashes from waste incineration.** Tateno, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Feb 1988. 16p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757190/JAW.

A system derived from the treatment of sludges from waste water and applied to radioactive waste processing is described. Calcined wastes in a container are heated by microwaves melted, solidified in the same container and conditioned for final storage.

21765 **(CONF-890207—7) Microwave processing of remote-handled transuranic wastes at Oak Ridge National Laboratory.** White, T.L.; Peterson, R.D.; Johnson, A.J. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007818/JAW.

From Waste management '89; Tucson, AZ, USA (26 Feb 1989).

The Oak Ridge National Laboratory (ORNL) Waste Handling and Packaging Plant (WHPP) is investigating the feasibility of applying microwave energy to melt Remote-Handled Transuranic (RH TRU) sludges. The initial bench-scale tests with surrogate sludges have shown that wet or dry surrogates can be processed into solid monoliths that meet the Waste Isolation Pilot Plant (WIPP) waste acceptance criteria (WAC). Sodium Nitrate ($NaNO_3$) binds the other solids when the wt% of $NaNO_3$ is greater than or equal to the wt% of the other solids. Microwave penetration depth experiments have shown that a wet slurrey absorbs microwave energy within a few cm of the slurry surface while dried surrogates below 100{degree}C are heated throughout the depth (20 cm) of the surrogate volume. The latest bench scale processing of wet surrogates has demonstrated good process control, provided that certain diagnostics which monitor, temperature, boiling absorbed microwave power, and arcing are implemented.

21766 **(CONF-890470—1) Transferring generic SARA/OSHA training to US Department of Energy facilities.** White, A.; McKinley, T. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400;AC05-76OR00033. 10p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007522/JAW.

From 8. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (23 Apr 1989).

The Technical Resources and Training Section staff at Oak Ridge National Laboratory have developed three extensive training programs for hazardous waste treatment, storage, and disposal facility workers a required by SARA/OSHA, 29 CFR 1910.120. The ORNL program is widely recognized as one of the best in the DOE system. ORNL and ORAU, who manages the Training Resources and Data Exchange (TRADE) network for DOE, entered into as cooperative relationship to respond to the many requests from DOE contractors for copies of the ORNL training materials. This discussion will describe the ORNL program and the process of turning it into a series of generic tools which can be used by additional DOE facilities to meet the training requirements established by SARA/OSHA, 20 CFR 1910.120. The speakers will describe how the materials are being used by DOE facilities as well as plans for additional resources to be developed through TRADE. 5 refs.

21767 **(CONF-890490—1) Microwave processing of radioactive materials-I.** White, T.L.; Berry, J.B. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005130/JAW.

From American Chemical Society Division of Environmental Chemistry meeting; Dallas, TX, USA (9 Apr 1989).

This paper is the first of two papers that reviews the major past and present applications of microwave energy for processing radioactive materials, with particular emphasis on processing radioactive wastes. Microwave heating occurs through the internal friction produced inside a dielectric material when its molecules vibrate in response to an oscillating microwave field. For this presentation, we shall focus on the two FCC-approved microwave frequencies for industrial, scientific, and medical use, 915 and 2450 MHz. Also, because of space limitations, we shall postpone addressing plasma processing of hazardous wastes using microwave energy until a later date. 13 refs., 4 figs.

21768 **(CRIE-T—87042) Effect of test temperature and sensitization on stress corrosion cracking of canister materials in air.** Mayuzumi, Masami. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jul 1988. 34p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756827/JAW.

The canister, as a container of vitrificated materials, is strictly required to keep soundly its hermetic seal over a long period of the fuel reprocessing waste storage and disposal process. In this report, chloride stress corrosion cracking (SCC) of canister materials in air was investigated. 2,000 hours tests of candidate canister materials (SUH 309, SUS 309S) with initial surface chlorine concentration on their SCC region were performed using constant load method under atmospheric condition with varying test temperature and relative humidity (R.H). As a result, decreasing R.H from 60% to 40% increased the allowable surface chlorine concentration more than 10 times. The lowest value of allowable surface chlorine concentration was obtained at 70°C. Degree of sensitization measured by electrochemical reactivation method (EPR value) was coincided with the allowable surface chlorine concentration. Any SCC was not observed in SUH 309 with a value of 5.7%. In order to prevent SCC, it is important to control salinity which has gotten mixed in the storage facility under construction, and to control a temperature of fluidized glass for vitrification. (22 figs, 4 tabs, 1 photo, 14 refs)

21769 **(DOE/OR/21548—038-Rev.2) Electrical power line and pole removal radiological survey completion report: Revision 2.** (MK-Ferguson Co., St. Charles, MO (USA); Jacobs Engineering Group, Inc., St. Charles, MO (USA)). Feb 1989. Contract AC05-86OR21548. 86p. NTIS, PC A05 - OSTI. Order Number DE89008419/JAW.

Each electric power pole and all wire, cross members, and attached hardware were radiologically surveyed and removed. The survey procedures did not conform in every respect with the planned procedures because the actual work differed from the removal plan. The survey showed that all contamination was fixed. Certain poles that were suspected of being contaminated with Th-230 were cut off one foot above ground level and left on site. Each truck load of materials was checked at the access point to ensure it met release criteria. Wood samples were taken from all the poles at Building 403 and 5% of all the rest and analyzed for U-238 and Th-232. Only U-238 was detected. 1903 bundles of wire (95,150 lin ft) were released, and 76 bundles (1520 lin ft) were found to be contaminated. 7163 lin ft of power pole material were released, and 1484 lin ft were contaminated. A comprehensive quality measure assurance/quality control program was applied to this work.

21770 **(DOE/RL—87-13) Hanford Waste Management Plan, 1987.** (Department of Energy, Richland, WA (USA). Richland Operations Office). 1987. 120p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008799/JAW.

The purpose of the Hanford Waste Management Plan (HWMP) is to provide an integrated plan for the safe storage, interim management, and disposal of existing waste sites and current and

future waste streams at the Hanford Site. The emphasis of this plan is, however, on the disposal of Hanford Site waste. The plans presented in the HWMP are consistent with the preferred alternative which is based on consideration of comments received from the public and agencies on the draft Hanford Defense Waste Environmental Impact Statement (HDW-EIS). Low-level waste was not included in the draft HDW-EIS whereas it is included in this plan. The preferred alternative includes disposal of double-shell tank waste, retrievably stored and newly generated TRU waste, one pre-1970 TRU solid waste site near the Columbia River and encapsulated cesium and strontium waste.

21771 **(DOE/RL—88-08) 300 area solvent evaporator interim status closure plan: Revision 2.** (Westinghouse Hanford Co., Richland, WA (USA)). Feb 1989. Contract AC06-87RL10930. 186p. NTIS, PC A09/MF A01 - OSTI. Order Number DE89008569/JAW.

This document describes activities for the closure of a hazardous waste tank treatment facility operated by the US Department of Energy-Richland Operations Office (DOE-RL) and co-operated by the Westinghouse Hanford Company (WHC). This treatment facility was a solvent evaporator located in the 300 Area of the Hanford Site, from 1975 to 1985 on behalf of DOE-RL. The 300 Area Solvent Evaporator (300 ASE) was a modified load lugger (dumpster) in which solvent wastes were evaporated. Some of the solvents were radioactively contaminated because they came from a degreaser which processed bare uranium metal billets from the N Reactor Fuel Manufacturing Facility. The waste was composed of perchloroethylene, trichloroethylene, 1,1,1-trichloroethane, ethyl acetate/bromine solution, paint shop solvents and possibly some used oil. Also, small amounts of uranium, copper, zirconium and possibly beryllium were present in the degreaser solvents as particulates. Radioactive and non-radioactive solvents were not segregated in the 300 ASE, and the entire mixture was regarded as mixed waste.

21772 **(DOE-RW—88.025) Large scale use of strippable coatings in preventative, tie-down and decontamination applications.** Sanders, M.J.; Pengelly, M.G.A. (UKAEA Atomic Energy Establishment, Winfrith (UK). Materials Technology Div.). (Department of the Environment, London (UK)). May 1985. 20p. (AEEW-R—1958; PCMWP-DDTF-P—67; PCMRP—86-P2). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705620/JAW.

The use of strippable coatings both to remove and prevent the radioactive contamination of equipment is discussed. Details of application by brush, roller, conventional (air) and airless spray are given. The use of strippable coatings to prevent the components of a re-useable temporary containment system from becoming contaminated is described and results of simple tests in which the coatings were used to remove plutonium dioxide contamination from a number of different surfaces in a Pressurised Suit Area are given. It is concluded that strippable coatings are particularly useful in contamination prevention and tie-down roles but test results indicate that they do not possess overwhelming advantages when used as a decontamination technique. The products used in the work reported here are water based.

21773 **(DOE-RW—88.090) Cement/slag chemistry studies.** Glasser, F.P.; Macphee, D.; Atkins, M.; Beckley, N.; Carson, S.O.; Wilding, C.R.; McHugh, G. (Aberdeen Univ. (UK); UKAEA Harwell Lab. Materials Development Div.). (Department of the Environment, London (UK)). 1988. 92p. NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705622/JAW.

The performance of cement-based matrices intended for radwaste immobilization is assessed. The long-term performance of the matrix is characterized by thermodynamic evaluation of experimental data. The results are presented in a general form, amenable to a range of specific formulations. The interaction of specific radwaste components with cements has been studied, using Iodine as an example. It occurs as both I/sup -/ and IO/sub 3//sup -/ species, but these differ sharply in sorption characteristics. The effect of ionizing radiation of the pH and E/sub h/ of cement matrices is reported.

21774 **(DP-MS—88-54) Investigation of high-temperature corrosion in an incinerator offgas system.** Jenkins, C.F. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1988. Contract AC09-76SR00001. 16p. (CONF-890437—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89002885/JAW.

From Corrosion '89; New Orleans, LA, USA (17 Apr 1989).

Corrosion studies have been carried out in the offgas system of a radioactive-waste incinerator at the Department of Energy's Savannah River Plant. Many advanced alloys exhibited severe corrosion and poor performance in the high-temperature region (>100{degree}C). The environment includes O_2, SO_3, P_2O_5 and HCl. Extensive corrosion for most alloys containing less than {approximately}25% Cr, and most iron-base materials were destroyed. An Fe-20Cr-5Al alloy had good appearance after exposure. Duplex chromium/aluminium diffusion coatings improve performance of substrate alloys having high Cr content. However, neither aluminizing nor chromizing alone provided sufficient benefit to warrant their use on the alloys examined. Carbon steel received no real long-term protection from either coating. Metallographic investigation indicates that reactions penetrate to substantial depths beneath the surface of most alloys. Where metal parts were cooled by air or water flow, corrosion was essentially eliminated. Thus, use of alloys with high chromium content (>30%), use of an iron-base alloy with aluminium plus chromium, application of duplex Cr/Al diffusion coatings on high-Cr materials, and application of water cooling to these high alloys each benefits reduction of high-temperature metallic corrosion in the incinerator offgas systems. 11 refs., 9 figs., 4 tabs.

21775 **(DP-MS—88-55) Waste handling: A study of tributyl phosphate compatibility with nonmetallic materials.** Jenkins, C.F.; Briedenbach, P.J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1989. Contract AC09-76SR00001. 12p. (CONF-890437—5). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005914/JAW.

From Corrosion '89; New Orleans, LA, USA (17 Apr 1989).

The need for numerous seals, plastic tubing, instrument components, and miles of plastic pipe for transferring process waste streams containing tributyl phosphate (TBP) and petroleum solvents led to an investigation of compatibility. TBP is a solvent for many plastics and elastomers and causes softening, crazing, or cracking of most nonmetallics tested. In this regard it may be considered an external plasticizer for some polymers. TBP also is a surfactant in aqueous solution. Dimension changes and property changes associated with softening will preclude the use of some materials as gaskets. Teflon{trademark} and Kalrez{trademark} gaskets appear to be compatible with TBP. Mixed results were obtained with EPDM elastomers, but EPDM O-rings are less costly than Kalrez{trademark} and are being applied in some areas. Exposure of CPVC rigid piping led to crazing and, ultimately, catastrophic stress cracking, thus precluding its use in the waste services described. High-density polyethylene and PVDF plastic piping were unaffected by the test exposures and are useable for process and process waste service. Applications include 25-30 miles of polyethylene pipe and a large number of EPDM gaskets in the filter assembly of an effluent treatment system at the Savannah River Plant. 3 refs., 7 figs., 3 tabs.

21776 **(DP-MS—89-17) Corrosion testing of high chromium alloys in simulated waste environments.** Corbett, R.A.; Bickford, D.F. (Savannah River Lab., Aiken, SC (USA)). 1989. Contract AC09-76SR00001. 18p. (CONF-890437—10). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007582/JAW.

From Corrosion '89; New Orleans, LA, USA (17 Apr 1989).

Incineration and vitrification of radioactive waste subjects equipment to alkaline or acid fluxing, oxidation, carburization, and sulfidation. Appropriate materials of construction must be selected to avoid rapid equipment failure. High chromium alloys have been tested in the laboratory using simulated waste formulations. Laboratory screening tests indicate that alloys with greater than 40% chromium provide superior resistance to attack. Ductile chromium is viable for submerged electrodes and equipment in the vapor

space, however, is subject to melt line attack at the glass/air/chromium interface of vitrification melters. 9 refs., 5 figs., 4 tabs.

21777 **(EGG-LLW—8054) Application of existing low-level waste technology offers 17-to-1 volume reduction and enhanced disposal at low cost.** Darnell, G.R.; Larsen, M.M.; Dalton, J.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1988. Contract AC07-76ID01570. 128p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009759/JAW.

This document provides a conceptual design of a low-level radioactive waste management complex in which an overall volume reduction of 17 to 1 is achievable using existing equipment in a simple, streamlined, waste treatment and disposal concept. The resultant densely packaged, fully treated waste is placed in enhanced-integrity, abovegrade, earth-mounded, concrete disposal vaults. The cost of constructing such a complex and operating it for 30 years, while treating and disposing of low-level waste at a rate equaling the average rate for Department of Energy disposal sites, is compared with the average cost of disposing of the same waste volume using past and current methods. This approach should meet or exceed state and federal regulations, while offering a low-cost disposal that will better preserve the environment. Although not specifically designed for individual waste streams at different sites, it can accommodate a considerable increase in waste volume and a considerable variance in waste composition. 7 refs., 20 figs., 9 tabs.

21778 **(EGG-M—88384) Working with the states to transport TMI-2 core debris.** Smith, T.A.; Anselmo, A.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1989. Contract AC07-76ID01570. 6p. (CONF-890207—20). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009732/JAW.

From Waste management '89; Tucson, AZ, USA (26 Feb 1989).

Close communications with state officials has been a key factor in success of the Three Mile Island Unit 2 core debris shipments. The US Department of Energy made extensive efforts to provide state officials with schedule information, answer technical questions, and satisfy concerns. Communications started before the campaign and continued during shipments and at intervals between shipments. Those efforts led to good working relationships with the states, kept governors and other state officials informed so they could respond to public concerns, provided the opportunity to recognize and respond to specific state concerns, facilitated state inspections, and provided avenues to avoid conflict and potential litigation. Good communications and working relationships with state officials also greatly benefited the community relations effort for the campaign. 6 refs.

21779 **(EGG-NERD—7444-Rev.1) Criticality safety evaluation for Pathfinder fuel elements in Model No. RA-3 shipping containers: Revision 1.** Jones, R.R. (EG and G Idaho, Inc., Idaho Falls (USA)). Jan 1989. Contract AC07-76ID01570. 39p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009748/JAW.

Pennsylvania State University presently possesses approximately 415 Pathfinder fuel elements which require shipment from their nuclear facility. It is planned to use Model No. RA-3 shipping containers for shipment of these elements. Certificate of Compliance No. 4986, Revision No. 18, Docket No. 71-4986 authorizes the use of these containers for Fissile Class I shipments of UO_2 fuel assemblies and UO_2 fuel rods with parameters similar to the Pathfinder fuel elements. Criticality safety calculations have been performed with the Monte Carlo code, KENO-V.a and 16-group Hansen-Roach cross sections for shipment of Pathfinder fuel elements in Model No. RA-3 shipping containers. The analysis is described and the results are given in this report. This analysis demonstrates that the RA-3 container with Pathfinder fuel elements complies with the requirements of 10 CFR 71.59 for Fissile Class II shipping containers with six as the allowable number of containers in a single shipment. 5 refs., 6 figs., 4 tabs.

21780 **(EGG-WM—8322) Buried waste program retrieval process conceptual model design.** Schillings, P.L.; Heiser, D.L.; Fogdall, S.P. (EG and G Idaho, Inc., Idaho Falls (USA)). Dec 1988. Contract AC07-76ID01570. 51p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009647/JAW.

This document describes the conceptual design of a computer simulation model to provide performance estimates, and assist in making decisions about the retrieval phase of the Buried Waste Program at the Radioactive Waste Management Complex. The model will be developed to address queueing, scheduling, materials handling, and transportation problems. Estimated values for significant parameters, not found by conventional means, will be determined through simulation runs. A functional model of the retrieval operations forms the basis for the conceptual design. This function diagramming model was developed using the IDEF/sub O/ methodology. It is presented first through a brief explanation of its construction and use, then by means of working diagrams. The IDEF/sub O/ model is composed of diagrams that interrelate inputs, outputs, controls, and mechanisms of various buried waste retrieval functions. These diagrams allow definition of the working scope of the retrieval process to any level of detail desired, but mainly provide direction for the computer simulation model to follow. A description of the proposed computer simulation model is given. This includes choice of simulation language (SIMAN), conceptual content, language design profile, software and hardware requirements, operating logic, and expected results. 6 refs., 5 figs., 1 tab.

21781 **(EPRI-NP—5670-Rev.1) Below Regulatory Concern Owners Group: Evaluation of candidate waste types: Revision 1: Final report.** Daloisio, G.S.; Deltete, C.P. (Electric Power Research Inst., Palo Alto, CA (USA); Analytical Resources, Inc., Sinking Springs, PA (USA)). Mar 1989. 125p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

There are several waste types produced at nuclear power plants that contain very low radioactivity concentrations and could be classified as Below Regulatory Concern (BRC), thus eliminating the need to dispose of such waste at licensed low-level waste disposal facilities. The Electric Power Research Institute (EPRI) has embarked on a program to develop the technical bases for a rulemaking petition authorizing BRC disposal of specific waste types. In order to focus the finite resources of time and money on those waste types which would provide the maximum benefit to the industry, an evaluation of potential BRC waste types was performed. This evaluation provides a systematic and documented approach to identify candidate BRC waste types for inclusion in the EPRI BRC program. The report identifies potential BRC waste types, defines appropriate evaluation/selection criteria, and provides an evaluation of each waste type with respect to these criteria. The final result of this evaluation is a prioritized list of BWR and PWR waste types, in decreasing order of attractiveness, suitable for inclusion in the EPRI BRC program. 7 refs., 33 tabs.

21782 **(EPRI-NP—5671-Rev.1) Below Regulatory Concern Owners Group: Radionuclide prioritization study, Revision 1: Final report.** Smith, C.F.; Phillips, L.B.; Williams, W.J. (Electric Power Research Inst., Palo Alto, CA (USA); Science Applications International Corp., Pleasanton, CA (USA)). Feb 1989. 96p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

The US Nuclear Regulatory Commission has indicated that a Below Regulatory Concern (BRC) rulemaking petition to exempt waste streams from the disposal requirements for low level radioactive waste should be based on actual expected nuclide concentration and variability. Because of variations in the importance and relative abundance of nuclides in waste, one or a small number of nuclides may control the determination of a waste stream as BRC. This study was conducted to evaluate the relative importance of the major radionuclides in dose assessments for the disposal options and geographic regions under consideration for BRC waste. 7 refs., 25 tabs.

21783 **(EPRI-NP—5681) Below Regulatory Concern Owners Group: Cost-benefit analysis of BRC waste disposal: Final report.** Nelson, R.A.; Tucker, R.F. Jr.; Wroble, J.R. (Electric Power Research Inst., Palo Alto, CA (USA); Sargent and Lundy, Chicago, IL (USA)). Mar 1989. 142p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Electric Power Research Institute (EPRI) commissioned a series of studies to provide support for a rulemaking petition to the Nuclear Regulatory Commission (NRC) to exempt certain types of very low-activity nuclear power plant wastes from NRC licensed disposal facilities. This report addresses the reduction in societal costs that will be associated with the below regulatory concern (BRC) disposal of very low-activity radioactive waste. The projected annual low-level radioactive waste (LLRW) volumes from nuclear power plants, institutional and industrial generators, and UF_6 conversion and the fraction of the nuclear power plant waste that could be disposed of as BRC waste are estimated. A qualitative cost-benefit analysis of this action is also performed. The cost savings to the nuclear power plant LLRW generators and to society was estimated for various disposal site capacities and fractions of the potential BRC waste that is disposed of as BRC waste. These cost savings are estimated for the nuclear power plants and for society. The effect on small LLRW generators and the present LLRW disposal facilities are addressed. The reduction in the use of the LLRW disposal facility capacity, the consumption of resources such as steel and diesel fuel, and potential heat recovery are addressed, in addition to items that are not readily quantified. The various BRC disposal options are also discussed. 8 refs., 4 figs., 34 tabs.

21784 **(EPRI-NP—5682) Below Regulatory Concern Owners Group: Evaluation of dry active waste monitoring instruments and techniques: Final report.** Thomas, V.W.; Endres, G.W.R.; Merwin, S.E.; Moeller, M.P.; Robertson, D.E.; Young, J.A. (Electric Power Research Inst., Palo Alto, CA (USA); Pacific Northwest Lab., Richland, WA (USA)). Mar 1989. Contract AC06-76RL01830. 156p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

The disposal of low-level radioactive waste (LLRW) is costly, so most nuclear power stations have found or will find that it is cost-effective to dispose of dry active waste (DAW) with activity levels that are Below Regulatory Concern (BRC) at a sanitary landfill or incinerator. It appears that substantial volumes of DAW can be exempted from disposal as LLRW if the maximum exposure to an individual member of the public from BRC waste does not exceed a few mrem per year effective dose equivalent. The Electric Power Research Institute (EPRI) has requested that Battelle, Pacific Northwest Laboratories (BNW) evaluate instruments and methods that could be used to measure surface contamination (activity per unit area) and radioactivity concentrations (activity per unit mass or volume) in BRC waste. Instrumentation utilized in a DAW BRC monitoring program must be capable of satisfying performance objectives. This instrumentations must measure bulk concentrations of radioactivity in DAW to assure that annual inventory disposal limits are not exceeded at each disposal site; measure radionuclide concentrations in disposal containers (e.g., bags, boxes, etc.) to assure that maximum allowable concentration limits in the DAW are not exceeded; assure that discrete radioactive particles (DRPs), if present in DAW, do not exceed maximum permissible activity limits; and possess detection capability to allow utilities to set operational limits between the detection limit and the disposal limit at their option. Our evaluations indicate that bag monitors and barrel counters have the necessary sensitivity to meet all of these objectives. 20 refs., 7 figs., 11 tabs.

21785 **(IAVM—9) Collection and removal of radioactive waste, coming from universities, high schools and academic hospitals.** Dignum, P.H.; Zwigt, A.; IAVM - Werkgroep stralingshygiene Collaboration. (Interuniversitaire Adviescommissie Veiligheids- en Milieuwetgeving (IAVM), Amsterdam (Netherlands). Onderwerpgroep Laboratoriumafval). Sum 1985. 58p. (In Dutch). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88706159/JAW.

In radionuclide laboratories of universities, radionuclides are employed for biomedical, chemical and physical research. In university hospitals, radionuclides are employed in vivo for diagnostic and therapeutic purposes and in vitro in tracer methods in chemical analysis. In general it concerns radioactive materials in dispersive form such as gases, fluids or powders (open sources). During operation with open sources radioactive waste originates with low specific activity. Regulations and recommendations concerning the collection and separation, transport, processing and eventual storage of this low-level radioactive waste are dealt with. 17 refs.; figs.; tabs.

21786 **(INIS-mf—11923) Investigations into the chemical status of C14 after leaching of cladding material from spent PWR and BWR fuel rods in a salt solution. Final report.** Bleier, A.; Beuerle, M.; Ellinger, M.; Bohlen, D. (Kraftwerk Union A.G., Erlangen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Apr 1988. 65p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88757369/JAW.

Following analysis of its C14 inventory, cladding material from spent PWR and BWR fuel rods was exposed to a saturated NaCl solution for 3 months at 200/sup 0/C in order to gain basic data on C14 behaviour after water ingress into a sealed repository. Cladding corrosion was initiated only after 100 ppm fluoride was added to the leaching medium. The C14 results obtained under these conditions indicate that cladding corrosion mobilizes about 50% of the C14 in PWR hulls and about 90% of the C14 in BWR hulls. The mobilized C14 is found ≧ 95% in the /sup 14/CO//sup 14/CH/sub 4/ fraction, whereas /sup 14/CO/sub 2/ at ≦ 5% represents a minority. Dissolving hulls in diluted hydrofluoric acid shows similar C14 species distribution. Because on the one hand the corrosion mechanism is not clear and on the other hand the fluoride in salt formations can be made inactive by other salt impurities or by the presence of concrete, further investigations into Zircaloy cladding corrosion are recommended. (orig.) With 8 refs., 10 tabs., 19 figs.

21787 **(JAERI-M—88-201) Progress report on safety research of high-level waste management for the period April 1987 to March 1988.** Nakamura, Haruto; Tashiro, Shingo (eds.) (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Oct 1988. 92p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757246/JAW.

Researches on high-level waste management at the High Level Waste Management Laboratory and the Waste Safety Testing Facility Operation Division of the Japan Atomic Energy Research Institute in the fiscal year of 1987 are reviewed in the three sections of the report. The topics are as follows: (1) On performance and durability of waste forms and engineered barrier materials, accelerated alpha radiation stability of glass form and Synroc has been investigated and stress corrosion cracking of canister materials was examined under simulated conditions. (2) Sorption of /sup 237/Np on granite samples and behavior of iron during weathering of granites were studied with respect to safety evaluation for geological disposal. (3) Actual waste was transported from the Tokai Reprocessing Plant and hot operation using the actual waste was initiated at WASTEF.

21788 **(JAERI-M—88-233) Volume reduction of ion exchange resins by catalytic incineration, 2. Bench scale test.** Yahata, Taneaki; Hirata, Masaru; Kurihara, Masayoshi; Terakado, Norimitsu. (Japan Atomic Energy Research Inst., Oarai, Ibaraki. Oarai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Nov 1988. 33p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757266/JAW.

Catalytic incineration of ion exchange resins using fluidized bed incinerator with copper monoxide catalyst installed in the freeboad was examined in order to obtain the data for the volume reduction of ion exchange resins with minimum tar and soot. The active alumina particles were fluidized with 1.4 Nm/sup 3//h air flow at about 750 deg C. The resins were supplied by screw feeder at the rate of ca. 0.2 kg/h. The resins were decomposed immediately at 750 deg C and the combustibles remaining in the off gas which were tar and soot could be changed into H/sub 2/O and

CO/sub 2/ by contacting with copper monoxide catalyst. By off gas analysis, about 50 ppm of CH/sub 4/, 25 ppm of CO and 1500 - 2000 ppm of SO/sub 2/ were detected. Though it was under condition of SO/sub 2/ existance, tar and soot were not observed in the off gas, by maintaining the catalyst temperature at 650 deg C. It was confirmed that catalytic incineration is applicable to the volume reduction of ion exchange resins.

21789 (Juel-Conf—62) **Reuse of residual materials from repair and dismantling of nuclear facilities.** Laser, M.; Halaszovich, S. (comps.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Jul 1988. 307p. (In German). (CONF-8711296—). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW.

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

A major concern in the reuse of decontaminated materials is the radiation levels permitted for various types of reuse, e.g. in the nuclear industry, in other types of restricted reuse, and in possible general public contact with the materials. This was discussed at length including the resulting worst case scenarios for calculation of the public maximum individual dose resulting from this reuse. Reuse programs as well as the major conclusions reached during this meeting concerning boundary radiation limits for various reuse techniques and the influence of these limits on radiation measuring techniques have been discussed in the papers. The different contributions have been prepared separately for inpunt into the databases INIS and ENERGY.

21790 (Juel-Conf—62, pp 92-125) **Results of preparatory planning for assessment of waste from decommissioning of the WAK.** Engelhardt, G.; Schneider, G.; Marx, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projektbereich Anlagen; IFM, Linkenheim-Hochstetten (Germany, F.R.)). Jul 1988. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW. (CONF-8711296—).

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

From the preparatory planning work for the decommissioning of the WAK, this report explains the assessments with regard to decontamination and dismantling of contaminated components, the decontamination of hot cells and other structural members in the areas with high-level radioactivity, as well as the relevant waste management, including disposal and probable recycling. Keeping the radiation exposure of the personnel as low as low possible, and minimizing the accruing waste are two major goals. The planning results assessing the radioactivity and materials mass inventory, the radiological categorization of the waste materials, and the relevant maximum permissible contamination levels are explained.

21791 (Juel-Conf—62, pp 136-149) **Radiological measurements for decontrol in the Gundremmingen nuclear power station, unit A.** Bergemann, L. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen/Guenzburg (Germany, F.R.)). Jul 1988. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW. (CONF-8711296—).

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

The licences for the decommissioning of the KRB-A for the first phase permit dismantling, decontamination, and radiological measurement of 100 tonnes of material which for the most part was to be suitable for recycling. The difficulties encountered in the mass-specific radiological measurements for classification of the solid waste into the recycling category determined by the licence provisions are explained, together with the special measuring methods developed for determining the surface contamination (digital pulse rate measurement).

21792 (Juel-Conf—62, pp 185-198) **Harmless utilization of metallic residual materials.** Hempelmann, W.; Pfeifer, W. Jul 1988. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW. (CONF-8711296—).

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

The paper discusses the various possibilities of treating metallic residual materials: (1) Crushing and compacting for direct ultimate disposal; (2) melting and conditioning for radiological decontrol and reuse; (3) decontamination for recycling in the conventional materials cycle. The conditions and requirements set in the licences for recycling and the methods applied for radiological measurements together with own work and results are presented.

21793 (Juel-Conf—62, pp 199-206) **Decontamination of components of parts removed from nuclear installations.** Schulz, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Abt. Dekontamination). Jul 1988. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW. (CONF-8711296—).

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

The paper summarizes the methods applied in the Juelich Nuclear Research Center for decontamination of metallic components removed from nuclear facilities, and discusses the problems encountered by means of selected practical examples also referring to the radiological measuring methods.

21794 (Juel-Conf—62, pp 207-245) **Experience so far in the melting of large amounts of radioactive scrap.** Sappok, M. (Siempelkamp Giesserei G.m.b.H. und Co., Krefeld (Germany, F.R.)). Jul 1988. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW. (CONF-8711296—).

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

The author describes the development and application of a method for the melting of scrap consisting of removed components from decommissioned nuclear facilities. The melting process under partial vacuum and the three-stage filtering system are explained, together with the regulatory aspects such as licensing procedure, radiological protection, and documentation of radiological measurements. With the melting method and equipment, more than 1.000 tonnes of material have been recovered so far, which were used to produce shielding slabs or doors and containers for nuclear use. Examples of practical efficiency are presented.

21795 (Juel-Conf—62, pp 246-261) **Utilization of metal scrap for the production of waste drums for ultimate disposal.** Janberg, K.; Rittscher, D. (Gesellschaft fuer Nuklearservice, Essen (Germany, F.R.)). Jul 1988. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW. (CONF-8711296—).

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

The contribution reviews the history of development of the techniques for treatment of decommissioning scrap from the beginning of the 1980's onwards (decommissioning of the Niederaichbach and Gundremmingen nuclear power stations), together with the radiological measuring methods required for regulatory purposes. The advantages of the recycling of the metal scrap by means of melting, and of materials utilization for production of waste containers for ultimate storage are discussed together with product quality assurance criteria.

21796 (Juel-Conf—62, pp 262-274) **Recycling of concrete.** Halaszovich, S. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Abt. Dekontamination). Jul 1988. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW. (CONF-8711296—).

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

The paper reviews potentials and problems of disposal or recycling of concrete removed from nuclear installations. Due to the difficulties in determining radioactivity limits that are compatible with utilization of recycled material in practice, a method is proposed that takes into account inhalation of dusts, as occurring during the reprocessing or recycling of the concrete, for instance in road building. This method is based on the maximum permissible radioactivity uptake by inhalation of a nuclide mixture of unknown composition.

21797 **(KAERI/RR—684/87) Development of radwaste disposal technology (III). The development of preliminary safety analysis methodology for the selection of candidate sites.** Park, Hun Hwee; Han, Kyung Won; Lee, Han Soo; Choi, Heui Joo; Lee, Youn Myoung; Park, Hee Seoung. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Feb 1988. 57p. (In Korean). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88706098/JAW.

This study is to develop a technology by which the radiological safety assessment for the low- and intermediate-level waste disposal site can be possible. For the priminary safety assessment, several accident or normal scenarios may be taken into account, but only 'well scenario' was considered providing the worst case. The nuclides liberated in 'well scenario' are H-3, Cs-137, and Sr-90 which many affect individual exposure remarkably. Before assessing the radiological safety for candidates, a sensitivity analysis for several parameter of the proposed model was carried out. The characteristics of rock of all candidates were assumed to be identical except for the groundwater velocity and distance to the well because of the limitation of site characteristic information. As the results of sensitivity analysis, the principal parameters controlling the individual dose mainly are the ground water velocity and fracture width concerning the rock properties. Based upon the results of sensitivity analysis, the safety assessment was applied to each candidate sites. Consequently, the candidate sites were categorized into three groups approximately according to maximum individual dose calculated for each site.

21798 **(KAERI/RR—685/87) Development of radwaste disposal technology (IV). A study on the establishment of the technical guidelines for site selection of a disposal repository.** Park, Hun Hwee; Han, Kyung Won; Lee, Jae Owan. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Mar 1988. 65p. (In Korean). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88706099/JAW.

Basic concepts on site selection have been reviewed and the technical guidelines for site selection of a disposal repository were established. The established guidelines provide the technical requirements for to and geologic characteristics, hydrology and hydrogeology, ecological environment and socioeconomic aspects. The conceptual and qualitative guidelines will be used in the selection of the radwaste disposal site in Korea.

21799 **(LA—11281-MS) Field evaluation of two shallow land burial trench cap designs for long-term stabilization and closure of waste repositories at Los Alamos, New Mexico.** Nyhan, J.; Drennon, B.; Hakonson, T. (Los Alamos National Lab., NM (USA)). Feb 1989. Contract W-7405-ENG-36. 96p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009132/JAW.

The results from several field experiments on methods to control soil erosion, biointrusion, and water infiltration were used to design and test a burial site cover which improves the ability of the disposal site to isolate the wastes. The performance of the improved cover design in managing water and biota at the disposal site was compared with a more conventional design widely used in the industry. The conventional trench cover design consists of 15 cm of sandy loam topsoil over 75 cm of sandy silt backfill, whereas the improved trench cover design consists of 75 cm of topsoil over a minimum of 25 cm of gravel and 90 cm of river cobble. Each plot was lined with an impermeable liner to allow for mass balance calculation of water dynamics and contains hydrologic tracer ions (iodide and bromide) to demonstrate movement of water through the various zones of the trench cap. Cesium was emplaced beneath the trench cap to indicate root penetration through the trench cap, observed by sampling plant samples collected on the plots and assaying them for cesium. The field data are summarized and discussed in terms of its usefulness for waste management decisions. 67 refs., 44 figs., 4 tabs.

21800 **(LA—11282-MS) Development of a prototype plan for the effective closure of a waste disposal site in Los Alamos, New Mexico.** Nyhan, J.; Barnes, F. (Los Alamos National Lab., NM (USA)). Feb 1989. Contract W-7405-ENG-36. 76p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009131/JAW.

The purpose of this study was to develop a prototype plan for the effective closure and stabilization of a semiarid low-level waste disposal site. This prototype plan will provide demonstrated closure techniques for a trench in a disposal site at Los Alamos based on previous shallow land burial (SLB) field research both at the Los Alamos Experimental Engineered Test Facility (EETF), and at a waste disposal area at Los Alamos. The accuracy of modeling soil water storage by two hydrologic models was tested by comparing simulation results with field measurements of soil moisture in eight experimental landfill cover systems at Waste Disposal Area B having a range of well-defined soil profiles and vegetative covers. Regression analysis showed that one of the two models tested represented soil moisture more accurately than the second model. The accuracy of modeling all of the parameters of the water balance equation was then evaluated using field data from the Integrated Systems Demonstration plots at the EETF. Optimized parameters were developed for one model to describe observed values of deep percolation, evapotranspiration, and runoff from the field plots containing an SLB trench cap configuration.

21801 **(LA—11283-MS) Development of technology for the long-term stabilization and closure of shallow land burial sites in semiarid environments.** Nyhan, J.W. (Los Alamos National Lab., NM (USA)). Feb 1989. Contract W-7405-ENG-36. 83p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009060/JAW.

The eight-year field research program involving the development of technology for the closure and stabilization of shallow land burial (SLB) sites is described. Results of field testing of biointrusion barriers at active waste disposal areas at Los Alamos and at the Los Alamos Experimental Engineered Test Facility (EETF) are reported. Field experiments performed in 6-m-deep caissons with a diameter of 3 m at the EETF are described in which the performance of migration and capillary barriers were tested. Finally, the results of model verification and validation efforts associated with hydrologic and chemical transport processes in the field experiments are described. 75 refs., 23 figs., 9 tabs.

21802 **(LA—11497-MS) Revised mineralogic summary of Yucca Mountain, Nevada.** Bish, D.L.; Chipera, S.J. (Los Alamos National Lab., NM (USA)). Mar 1989. Contract W-7405-ENG-36. 68p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008957/JAW.

We have evaluated three-dimensional mineral distribution at Yucca Mountain, Nevada, using quantitative x-ray powder diffraction analysis. All data were obtained on core cuttings, or sidewall samples obtained from drill holes at and around Yucca Mountain. Previously published data are included with corrections, together with new data for several drill holes. The new data presented in this report used the internal standard method of quantitative analysis, which yields results of high precision for the phases commonly found in Yucca Mountain tuffs including opal-CT and glass. Miner-

alogical trends with depth previously noted are clearly shown by these new data. Glass occurrence is restricted almost without exception to above the present-day static water level (SWL), although glass has been identified below the SWL in partially zeolitized tuffs. Silica phases undergo well-defined transitions with depth, with tridymite and cristobalite occurring only above the SWL, opal-CT occurring with clinoptilolite-mordenite tuffs, and quartz most abundant below the SWL. Smectite occurs in small amounts in most samples but is enriched in two distinct zones. These zones are at the top of the vitric nonwelded base of the Tiva Canyon Member and at the top of the basal vitrophyre of the Topopah Spring Member. Our data support the presence of several zones of mordenite and clinoptilolite-heulandite as shown previously. New data on several deep clinoptililite-heulandite samples coexisting with analcime show that they are heulandite. Phillipsite has not been found in any Yucca Mountain samples, but erionite and chabazite have been found once in fractures. 21 refs., 17 figs.

21803 **(LA—11544-MS) Modeling of radionuclide transport at inactive material disposal Area T, TA-21.** Devaurs, M. (Los Alamos National Lab., NM (USA)). Apr 1989. Contract W-7405-ENG-36. 56p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009014/JAW.

Existing Area T data are used to extract information on radionuclide movement to assist in design of future characterization studies. Spatial moment estimation was used in conjunction with the one-dimensional convective-dispersive solute transport equation to describe radionuclide transport. With available data and conservative assumptions, we obtained gross estimates of radionuclide movement rates. Recommendations are made on how this information could guide further drilling/sampling for contamination at Area T. 24 refs., 16 figs., 6 tabs.

21804 **(LBL—24758) Geotechnical support and topical studies for nuclear waste geologic repositories: Annual report, fiscal year 1987.** (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 143p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008839/JAW.

This multidisciplinary project was initiated in fiscal year 1986. It comprises 11 reports in two major interrelated tasks: The technical assistance part of the project includes reviewing the progress of the major projects in the DOE Office of Civilian Radioactive waste Management (OCRWM) Program and advising the Engineering and Geotechnology Division on significant technical issues facing each project; analyzing geotechnical data, reports, tests, surveys and plans for the different projects; reviewing and commenting on major technical reports and other program documents such as Site Characterization Plans (SCP) and Study Plans; and providing scientific and technical input at technical meetings. The topical studies activity comprises studies on scientific and technical ions and issues of significance to in-situ testing, test analysis methods, and site characterization of nuclear waste geologic repositories. The subjects of study were selected based on discussions with DOE staff. One minor topic is a preliminary consideration and planning exercise for postclosure monitoring studies. The major task, with subtasks involving various geoscience disciplines, is a study of the mechanical, hydraulic, geophysical and geochemical properties of fractures in geologic rock masses.

21805 **(LBL—25505) Critical parameters and measurement methods for post closure monitoring: A review of the state of the art and recommendations for further studies.** Morrison, H.F.; Majer, E.L.; Tsang, C.F. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 60p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008416/JAW.

Both NRC and EPA regulations require programs of post closure monitoring to detect substantial and detrimental deviations from expected performance. The unexpected in this case would involve anomalous stress changes that might rupture the canisters or changes in the hydrologic regime that might accelerate corrosion. In the event of leakage brought about by any means transport of radionuclides to the accessible environment could occur through unexpected changes in the hydrologic flow regime caused either by the long term effects of the thermal loading by the waste or by changes in regional stress or hydrology. Studies of performance confirmation have identified six parameters or conditions that should be monitored that are associated with the thermal, mechanical and hydrologic phenomena introduced by the waste heat: temperature, stress, displacement, pore pressure, groundwater velocity and permeability. Since it is the thermal load that continues to increase after decommissioning, and which continues to alter the stress field and the hydrological regime, these same six parameters remain the critical ones in post closure monitoring. At two of the repository sites fractures have been clearly shown to be critical in modelling and performance confirmation; at the tuff site fluid saturation is also a critical parameter and for all the sites estimates of the groundwater velocity through the site are very important. Changes in fracture properties, saturation and fluid flow are thus of continuing importance in post closure monitoring. 14 refs., 19 figs.

21806 **(NAGRA-NTB—88-17) Investigations on site suitability for a final repository of low-and intermediate-level radioactive wastes. Status report of phase I investigations for the feasible Bois de la Glaive site (community of Ollon, VD).** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Oct 1988. 84p. (In French). Nagra, CH-5401 Baden, Switzerland.

On 30/sup th/ September 1985, site suitability investigations with a view to disposal of low- and intermediate-level radioactive waste were licensed by the Federal Government at three locations - Bois de la Glaive (Canton Vaud), Oberbauenstock (Canton Uri) and Piz Pian Grand (Canton Graubuenden). This report presents the status of the investigations at Bois de la Glaive as at the end of 1987 and discusses the results of the programme. Because of the opposition of the community of Ollon, none of the investigations subject to authorization have been carried out, even though these investigations had been approved by the Federal Government on 30/sup th/ September 1985. Nevertheless, various investigations not requiring a license have provided a considerable store of data. The details of the work actually carried out are as follows: (1) Detailed geological mapping of the earth's surface over an area of 22.5 km/sup 2/ on a scale of 1:5000. This study included the first geological recording of the Galerie de Salin (Salin drift) which formed part of an 18/sup th/-century mine. (2) The existing hydrogeological data on the area were compiled and provided a first impression of the overall hydrogeological conditions. (3) The provisional concept of a possible repository at Bois de la Glaive and of the corresponding exploration gallery was elaborated under the point of view of civil engineering and the long-term behaviour of the host rock was assessed qualitatively. To summarize, based on the present stage of the investigations and on rock- resp. site-specific knowledge of the anhydrite as a host rock, there are no real reasons for ruling out the site. 54 refs., 11 figs.

21807 **(NAGRA-NTB—88-18) Investigations on site suitability for the final disposal of low-and intermediate-level radioactive wastes. Status report of phase I investigations for the feasible Oberbauenstock site (community of Bauen, UR).** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Oct 1988. 322p. (In German). Nagra, CH-5401 Baden, Switzerland.

By way of introduction, the report presents the initial research guidelines created by the granted licenses, and the influence this had on the associated investigation objectives and performance. Following this discussion, an overview of available data and a description of investigations conducted for the site are presented. The second chapter presents results of the geological investigation program. Information concerning the structural geology of the area was obtained by regional studies, local surface mapping and geophysical measurements in boreholes. The results of these new studies were integrated into an updated tectonic model, which provides an improved conception of geological conditions at the site. Contained also within the chapter is a summary of: the lithologic and stratigraphic data obtained from boreholes; a description of mineralogical investigations and related results; and physical parameter determinations obtained from geophysical surveys. A physical description of the hydrologic flow-systems encountered is then presented on the basis of the geological, lithological, and mineralogical data obtained. The third chapter is dedicated to studies which, based on the results of the previously described investigations,

assess the feasibility of a potential repository from a technical and safety point of view. The fourth and final chapter summarises the results of the investigation program and draws relevant conclusions, the most important of which are: Investigations conducted to date have not revealed any reasons for ruling out Oberbauenstock as a potential repository site. Additional investigations which will advance the present state of knowledge are feasible only in conjunction with construction of an exploratory drift. 94 refs., 74 figs., 59 tabs.

21808 **(NAGRA-NTB—88-19) Investigations of site suitability for the final disposal of low- and intermediate-level radioactive wastes. Status report of phase I investigations for the feasible Piz Pian Grand site (communities Mesocco and Rossa, GR).** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Oct 1988. 164p. (In German). Nagra, CH-5401 Baden, Switzerland.

On 30/sup th/ September 1985, the Federal Government granted Nagra permission to investigate the three potential sites Bois de la Glaive, Oberbauenstock and Piz Pian Grand with a view to assessing their suitability for disposal of low- and intermediate-level radioactive waste. This report summarises the investigations carried out at Piz Pian Grand, together with the results obtained during the course of the programme. The first chapter discusses the key aspects of planning and performing the work and outlines the general objectives of the research. It also gives a brief time-schedule for the investigations. The results of the geological investigations are detailed in chapter 2. Starting with an overview of existing data on the area, the report goes on to give as comprehensive as possible a picture of the geological and hydrogeological conditions found to exist on analysis of the investigation results. The modelling studies and a provisional engineering concept for a potential repository for low-and intermediate-level waste are described in chapter 3. The fourth and final chapter summarises all the aforementioned results. It can be concluded that there are no grounds for ruling out Piz Pian Grand as a potential site. The data required for a more detailed assessment of the suitability of the area for low- and intermediate-level waste disposal can only be obtained by constructing an exploratory drift. 37 refs., 34 figs., 14 tabs.

21809 **(NAGRA-NTB—88-20) Investigations on site suitability for the final disposal of low- and intermediate-level radioactive wastes. Overview of phase I investigations for the feasible sites Bois de la Glaive, Oberbauenstock and Piz Pian Grand.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Oct 1988. 232p. (In German, French, Italian). Nagra, CH-5401 Baden, Switzerland.

The restricted Phase 1 investigations were insufficient to allow a final assessment of site suitability. Nagra's research during this Phase therefore concentrated on identifying possible grounds on which a particular site would have to be ruled out, i.e. investigations were directed towards assessing the most important geological and hydrogeological aspects of site selection which are relevant from a safety point of view. The results of this work led to the following conclusions: At none of the three sites were there indications of any geological, hydrogeological or rock mechanical conditions which might prove prohibitive to the safe disposal of low- and intermediate-level radioactive waste. The absence of such adverse conditions was confirmed at Oberbauenstock and Piz Pian Grand by way of field studies which exhausted the Phase 1 investigation possibilities. The present state of knowledge on these two sites can not be improved without construction of an exploratory tunnel. At Bois de la Glaive, actual field investigations were thwarted by politically motivated opposition in the community. However, the picture of geological, hydrogeological and rock mechanical conditions provided by the detailed surface mapping programme gave no indication that the site would fail to meet the disposal safety criteria. There are therefore no reasons for ruling out this site. Nagra is therefore requesting that the Federal Government should license construction of exploratory tunnels and related investigation programmes to assess the host rock at all three sites. 17 refs., 15 figs., 18 tabs.

21810 **(NUKEM-FuE—87050) Development of waste forms for ultimate storage of HTR fuel elements. Final report.** Ganser, B.; Mehner, A.W. (Nuklear-Chemie und - Metallurgie G.m.b.H. (NUKEM), Hanau (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1988. 94p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757378/JAW.

By assignment of the Federal Ministry for Research and Technology, studies were carried out within the framework of the HBK outline programme for the direct final disposal of burnt HTR fuel elements according to the concept of the LWR-MAW hole emplacement of 400-l-barrels. The studies were divided into two parts: (a) a systems analysis, in which the marginal conditions known today for this storage variant were collected and evaluated according to the conditioning methods; (b) experiments, in which model tests on the mechanical behaviour of HTR fuel elements under conditions of final storage were carried out. The reflections in the field of systems analysis showed that the known marginal conditions are still unsatisfactory from the viewpoint of safety. In the experiment the unirradiated HTR fuel elements were subjected to a pressure of 25 MPa in model barrels (1 ball, 21 balls, 180-l-barrels). The results thereof were essentially a confirmation of the findings of the systems analysis.

21811 **(OPLA—86-15) Investigation concerning geologic storage of radioactive waste in the Netherlands. First intermediate report about stage 1 (September 1984-December 1985).** (Ministerie van Economische Zaken, The Hague (Netherlands). Commissie Opberging te Land). 17 Feb 1986. 56p. (In Dutch). (IL—177). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88706268/JAW.

The first stage of the research program concerning geological storage of radioactive waste in the Netherlands encloses desk studies for the preparation of a selection out of a number of locations for closer field examination, and of a choice of the most proper storage technique (mines, deep boreholes, caverns). This report is the first of two intermediate reports concerning the state of affairs of this first stage. 10 refs.; 6 figs.

21812 **(ORNL/TM—10915) A preliminary assessment of selected atmospheric dispersion, food-chain transport, and dose-to-man computer codes for use by the DOE Office of Civilian Radioactive Waste Management.** Riggle, K.J.; Roddy, J.W. (Oak Ridge National Lab., TN (USA)). Feb 1989. Contract AC05-84OR21400. 86p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008968/JAW.

This work is part of the ongoing Systems Modeling Program at Oak Ridge National Laboratory, which is assisting the DOE Office of Civilian Radioactive Waste Management in selecting appropriate computer codes for the process of licensing a high-level radioactive waste repository or a monitored retrievable storage facility. A preliminary study of codes for predicting dose to man following airborne releases of radionuclides is described. These codes use models for estimating atmospheric dispersion of activity and deposition onto the ground surface, exposures via external irradiation, inhalation of airborne activity, and ingestion following transport through terrestrial food chains, and the dose per unit exposure for each exposure mode. A set of criteria is given for use in choosing codes for further examination. From a list of over 150 computer codes, five were selected for review.

21813 **(PNL-SA—15764) Sensitivity and uncertainty analyses for performance assessment modeling.** Doctor, P.G. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 29p. (CONF-880872—7). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009155/JAW.

From Joint statistical meetings; New Orleans, LA, USA (22 Aug 1988).

Sensitivity and uncertainty analyses methods for computer models are being applied in performance assessment modeling in the geologic high level radioactive waste repository program. The models used in performance assessment tend to be complex physical/chemical models with large numbers of input variables. There

are two basic approaches to sensitivity and uncertainty analyses: deterministic and statistical. The deterministic approach to sensitivity analysis involves numerical calculation or employs the adjoint form of a partial differential equation to compute partial derivatives; the uncertainty analysis is based on Taylor series expansions of the input variables propagated through the model to compute means and variances of the output variable. The statistical approach to sensitivity analysis involves a response surface approximation to the model with the sensitivity coefficients calculated from the response surface parameters; the uncertainty analysis is based on simulation. The methods each have strengths and weaknesses. 44 refs.

21814 **(PNL-SA—16486) Restoration of areas disturbed by site studies for a mined commercial radioactive waste repository: The Basalt Waste Isolation Project [BWIP].** Brandt, C.A.; Rickard, W.H. Jr.; Biehert, R.W.; Newell, R.L.; Page, T.L. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1989. Contract AC06-76RL01830. 2p. (CONF-890192—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008250/JAW.

From Symposium on restoration: the new management challenge; Oakland, CA, USA (16 Jan 1989).

The Basalt Waste Isolation Project (BWIP) was undertaken to environmentally characterize a portion of the US Department of Energy's Hanford Site in Washington State as a potential host for the nation's first mined commercial nuclear waste repository. Studies were terminated by Congress in 1987. Between 1976 and 1987, 72 areas located across the Hanford Site were disturbed by the BWIP. These areas include borehole pads, a large Exploratory Shaft Facility, and the Near Surface Test Facility. Most boreholes were cleared of vegetation, leveled, and stabilized with a thick layer of compacted pit-run gravel and sand. The Near Surface Test Facility consists of three mined adits, a rock-spoils bench, and numerous support facilities. Restoration began in 1988 with the objective of returning sites to pre-existing conditions using native species. The Hanford Site retains some of the last remnants of the shrub-steppe ecosystem in Washington. The primary constraints to restoring native vegetation at Hanford are low precipitation and the presence of cheatgrass, an extremely capable alien competitor. 5 figs.

21815 **(PNL-SA—16603) Treatment of hazardous metals by in situ vitrification.** Koegler, S.S.; Buelt, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1989. Contract AC06-76RL01830. 16p. (CONF-890285—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008247/JAW.

From DOE HAZWRAP conference; Denver, CO, USA (1 Feb 1989).

Soils contaminated with hazardous metals are a significant problem to many Defense Program sites. Contaminated soils have ranked high in assessments of research and development needs conducted by the Hazardous Waste Remedial Action Program (HAZWRAP) in FY 1988 and FY 1989. In situ vitrification (ISV) is an innovative technology suitable for stabilizing soils contaminated with radionuclides and hazardous materials. Since ISV treats the material in place, it avoids costly and hazardous preprocessing exhumation of waste. In situ vitrification was originally developed for immobilizing radioactive (primarily transuranic) soil constituents. Tests indicate that it is highly useful also for treating other soil contaminants, including hazardous metals. The ISV process produces an environmentally acceptable, highly durable glasslike product. In addition, ISV includes an efficient off-gas treatment system that eliminates noxious gaseous emissions and generates minimal hazardous byproducts. This document reviews the Technical Basis of this technology. 5 refs., 7 figs., 2 tabs.

21816 **(SAND—86-2710) Fire testing and analysis of TRUPACT-I Thermal Test Article.** Romesberg, L.E.; Longenbaugh, R.S.; Joseph, B.J. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1989. Contract AC04-76DP00789. 111p. (TTC—0704). NTIS, PC A06 - OSTI. Order Number DE89008510/JAW.

This report documents the fabrication and thermal test of a full-scale prototype of the revised TRUPACT-I design. The fire test demonstrated that the response of the Test Article to a jet-fueled pool fire, subsequent to the impact and puncture tests, meets the impact, puncture, and thermal performance requirements of the regulations governing transport of radioactive materials. The Test Article was a replica of the front half (closure end) of the revised TRUPACT-I design. To simulate the cumulative effect of the regulatory hypothetical accident sequence, the Test Article included the structural damage found in TRUPACT-I, Unit 0 after regulatory drop and puncture testing. The Test Article was totally engulfed in a pool fire fueled by JP-4 jet fuel for 46 minutes. The maximum temperature reached at the inner door seals was 149{degree}C (300{degree}F) and the maximum temperature at the inner door filters was 171{degree}C (340{degree}F). Both temperatures are within the normal working range for these components. Post-test leak rate measurements of 0.0041 atm-cm^3/s (ANSI standard air) between the innermost pair of door seals and 0.0046 atm-cm^3/s (ANSI standard air) between the outermost pair of door seals verified that the performance of the silicone seals met the design requirements. Since no detectable leakage was measured to a sensitivity of 1.0E-7 atm-cm^3/s for the filter installation seal or quick-connect valve seal post-test, the total leak rate for the containment system was less than the maximum allowable 0.01 atm-cm^3/s (ANSI standard air). 10 refs., 52 figs., 5 tabs.

21817 **(SAND—88-0660) Compliance and strength of artificial joints in Topopah Spring tuff: Yucca Mountain Project.** Olsson, W.A. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1988. Contract AC04-76DP00789. 121p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009001/JAW.

Capabilities for predicting the response of rock masses to thermomechanical loadings are being developed under the Yucca Mountain Project (YMP) for the design of an underground nuclear waste repository at Yucca Mountain on the Nevada Test Site (NTS). An important ingredient in the computer codes being used is the constitutive description of the mechanical discontinuities (mostly joints, but also bedding planes and faults). This report summarizes preliminary laboratory experimental data on the compliance and the friction stress of artificial joints in Topopah Spring tuff in the air-dry, room-temperature condition. Also, data for a laboratory-induced, clean tensile fracture are given. Details of the analysis of the results are discussed in earlier reports. Therefore, the reader is urged to judiciously use data in this report, consulting the earlier documents when necessary. This report is primarily a catalogue of experiments and a summary of results; hence, little further analysis is given. Because of the exploratory nature of the investigation, a systematic data base was not developed for the variables (such as sliding velocity, amount of slip, and normal stress history) studied. The results suggest guidelines for further, more systematic, experimentation on fracture properties. It is critical to clearly understand the nature of the data and their implication; therefore, in the next section the constitutive relations for a joint are defined and the methods for their determination are explained. 15 refs., 89 figs.

21818 **(SAND—88-1381C) Evaluating alternative design philosophies for spent nuclear fuel transport casks using a comparative probabilistic risk assessment approach.** Lake, W.H.; Sanders, T.L. (Sandia National Labs., Albuquerque, NM (USA)). [1988]. Contract AC04-76DP00789. 33p. (CONF-890405—1; TTC—0812). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004583/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

A PRA approach which uses comparison of alternative safety systems is proposed. The method assumes a linear risk model, and uses a selected probability function to compare the system of interest and an acceptable reference system. Features of the reference system may be varied to assess effects on system safety. The method is demonstrated by addressing effects of burnup credit on criticality control, an issue of current interest in the area of transport of radioactive materials. The example illustrates how the method measure effects of system changes, and how compensatory features can be introduced and assessed in terms of risk or reliability control. 6 refs., 7 figs.

21819 **(SAND—88-1411C) Thermal aspects of the subseabed disposal of high-level radioactive waste.** Hickox, C.E.; Percival, C.M.; Olson, L.O. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 34p. (CONF-890193—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008683/JAW.

From Geotechnical aspects of ocean waste disposal; Orlando, FL, USA (26 Jan 1989).

Since 1974, the subseabed disposal of nuclear waste has been under investigation as an alternative to land based options for nuclear waste disposal. Research into the subseabed alternative has been conducted by the Subseabed Disposal Program. Research conducted within the Subseabed Disposal Program follows an established procedure for the development of mathematical models used to assess concept feasibility. The procedure consists of identification of relevant physical processes and construction of mathematical models to describe these processes, acquisition of data required by the models, application of the models to provide solutions to well defined problems, and acquisition of laboratory and field data to validate model predictions. The authors have conducted research in several areas that are directly related to thermal aspects of nuclear waste disposal in the seabed, and which reflect the research philosophy just described. In this paper we provide an overview of the most important results of several of these studies. 10 refs., 10 figs., 3 tabs.

21820 **(SAND—88-2838C) WIPP/SRL international in situ testing program: MIIT [Materials Interface Interactions Tests].** Wicks, G.G.; Molecke, M.A. (Sandia National Labs., Albuquerque, NM (USA); Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC04-76DP00789;AC09-76SR00001. 19p. (CONF-8810189—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009330/JAW.

From Commission of European Communities workshop on testing of high level waste glass under repository conditions; Cadarache, France (17 Oct 1988).

On July 22, 1986, the largest and most cooperative international effort directed at in situ testing of simulated waste glasses was officially begun. This program, called the Materials Interface Interactions Tests (MIIT), involves the underground emplacement of almost 2000 simulated HLW samples, package components, and eologic samples in the bedded salt site at the Waste Isolation Plant (WIPP), near Carlsbad, New Mexico. Samples were supplied by researchers in the United States, France, Germany, Canada, Belgium, Japan, and the United Kingdom. Data and sample performance are being assessed and analyzed by laboratories and universities in each of the participating countries and additional nations also. Samples have been retrieved after 0.5, 1, and 2 years of burial with only the 5 year samples still in test. There are hundreds of samples available for study and many analyses are currently in progress. At present, even though only a small portion of all the data available has been obtained and analyzed, important effects and trends are already emerging. An overview of the MIIT will be presented along with a summary of preliminary findings on performance of Savannah River (SR) waste glass in the WIPP MIIT. 20 refs., 8 figs.

21821 **(SAND—88-3005) A review of the safety features of 6M packagings for DOE programs.** (Sandia National Labs., Albuquerque, NM (USA); USDOE, Washington, DC). Dec 1988. Contract AC04-76DP00789. 132p. (TTC—0879). NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008936/JAW.

This report, prepared by a US Department of Energy (DOE) Task Force and organized for clarity into two-page modules, argues that the US Department of Transportation (DOT) Specification-6M packagings (hereafter referred to as 6M packaging, or simply 6M) merit continued DOE use and, if necessary, DOE certification. This report is designed to address the specific requirements of a Safety Analysis Report for Packaging (SARP). While not a SARP, this report constitutes a compilation of all available documentation on 6M packagings. The authors individually, and the Task Force collectively, believe their investigation provides justification for the continued use of 6M packagings because they meet criteria for quality assurance and for safety under normal and accident conditions as defined by the US Nuclear Regulatory Commission (NRC) regulations. This report may be used by DOE managers to assist in deliberations on future requirements for 6M packagings as they are required to support DOE programs. For the purpose of ready evaluation, this report includes categorical topics found in Nuclear Regulatory Guide 7.9, the topical guideline for SARPs. The format, however, will (it is hoped) pleasantly surprise customary reader expectations. For, while maintaining categorical headings and subheadings found in SARPs as a skeleton, the Task Force chose to adopt the document design principles developed by Hughes Aircraft in the 1960s, "Sequential Thematic Organization of Publications" (STOP). 37 figs.

21822 **(SAND—89-0638C) Generalized simulation environment for repository and factory design.** Griesmeyer, J.M. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1989. Contract AC04-76DP00789. 12p. (CONF-890304—34). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008578/JAW.

From 3. ANS topical meeting on robotics and remote systems; Charleston, SC, USA (13 Mar 1989).

The FAC-SIM factory simulation environment provides systems analysis capabilities during the natural top-down design process for industrial facilities. Models can be constructed and simulations run for coarse descriptions of facility systems and process operations. Detail can be added incrementally to the models as the design progresses. Simulations run with FAC-SIM can identify critical subsystems and determine the impacts of variations in system design and operations. The graphical and hierarchical representations of both physical objects and operations are the unique features of FAC-SIM that permit ease of top-down simulations. This paper describes the FAC-SIM environment and its use in the ongoing development of the Repository Simulation System, REPSIMS, for the analysis of surface facilities at geological repositories for radioactive waste. 13 refs., 5 figs., 5 tabs.

21823 **(UCRL—100029) Modeling the release and dispersion of hazardous materials with complex behavior.** Rodean, H.C. (Lawrence Livermore National Lab., CA (USA)). Mar 1989. Contract W-7405-ENG-48. 12p. (CONF-8904128—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008802/JAW.

From Joint Army-Navy-NASA-Air Force safety and environmental protection; San Antonio, TX, USA (3 Apr 1989).

A mathematical model for the release and dispersion of hazardous materials in the atmosphere necessarily includes a submodel for the materials. Two toxic materials with complex behavior, uranium hexafluoride (UF_6) and nitrogen tetroxide (N_2O_4) are used to illustrate the modeling of phase change in combination with chemical reactions. The properties of these materials including their phase diagrams, the dissociation of N_2O_4 into NO_2 and the reactions of UF_6 and N_2O_4 with water are reviewed. The models presented for mixtures of UF_6 and N_2O_4 with dry and moist air are based on thermodynamic equilibrium, the ideal gas law, temperature-dependent saturation vapor pressure equations, a temperature-dependent equilibrium constant for the $N_2O_4 = 2NO_2$ reaction, and the reactions of UF_6 and N_2O_4/NO_2 with H_2O. Available evidence gives support to the assumed product, the nitric acid-water azeotrope. The material model equations are written in terms of pressure ratios and dimensionless parameters. The solutions of these equations are used to construct equilibrium diagrams with temperature and the mass fraction of the material in the mixture as the principal coordinates. Curves for constant values of vapor mass fraction, extent of N_2O_4 dissociation, and extent of chemical reaction are plotted in these diagrams. It is shown that there is much common structure among the models for UF_6 and N_2O_4 mixed with dry and moist air. The last part of the study consists of the solution of heat balance equations for the release of superheated UF_6 that is subsequently mixed with air. These solutions are plotted for three cases: mixing with dry air, mixing with moist air but assuming no chemical reaction, and mixing with moist air with the UF_6-H_2O reaction. 16 refs., 6 figs.

21824 **(WHC-EP—0182-7) Tank Farm Surveillance and Waste Status Summary Report for October 1988.** Thurman, J.M. (Westinghouse Hanford Co., Richland, WA (USA)). Dec 1988. Contract AC06-87RL10930. 30p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008804/JAW.

This report is Westinghouse Hanford Company's official inventory for high-level radioactive waste stored in underground tanks at the Hanford Site. Data that depict the status of stored, high-level waste and tank vessel integrity are contained within the report. The intent of the report is to provide data on each of the existing 177 underground waste tanks, as well as to provide supplemental information regarding tank equipment, tank anomalies, and ongoing investigations.

21825 **(WHC-EP—0182-9) Tank Farm Surveillance and Waste Status Summary Report for December 1988.** Thurman, J.M. (Westinghouse Hanford Co., Richland, WA (USA)). Jan 1989. Contract AC06-87RL10930. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008803/JAW.

This report is Westinghouse Hanford Company's official inventory for high-level radioactive waste stored in underground tanks at the Hanford Site. Data that depict the status of stored, high-level waste and tank vessel integrity are contained within the report. The intent of the report is to provide data on each of the existing 177 underground waste tanks, as well as to provide supplemental information regarding tank equipment, tank anomalies, and ongoing investigations.

21826 **(WHC-SA—0097) Use of Bayesian analysis for incorporating subjective information.** Eslinger, P.W.; Sagar, B. (Westinghouse Hanford Co., Richland, WA (USA)). Sep 1987. Contract AC06-87RL10930. 19p. (CONF-870971—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008708/JAW.

From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA (15 Sep 1987).

Large uncertainties are inherent in characterizing geologic media and in defining the future conditions under which geologic repositories must perform. Therefore, incorporating subjective information is an important aspects of quantitative assessment of repository performance. One method of incorporating subjective information in a quantitative analysis is demonstrated in this paper. Lacking objective data from laboratory and field tests, subjective information is coded to form prior distributions of the unknown parameters of the distribution of a variable. However, this presents some complications, as will be discussed further. As objective data are obtained, Bayes theorem is used to derive estimates of the parameters. The use of conjugate prior distributions for performing this analysis is also discussed. Two applications for the Basalt Waste Isolation Project (BWIP) are presented. The first pertains to subjective information obtained through probability encoding of the two parameters of the distribution of effective porosity at the macro scale. Only one measured value of effective porosity is currently available. Estimates for the two parameters are obtained by incorporating the single data point. The example is extended further to illustrate the effects that additional data may have on estimating the posterior distributions. The second application is for hydraulic transmissivity in a multivariate setting. No multivariate data are currently available. 10 refs., 10 figs., 2 tabs.

21827 **(WHC-SA—0424) Resource Conservation and Recovery Act compliance at the Hanford Site.** Bracken, E.A.; Badden, J.W.; Wiegman, S.A. (Westinghouse Hanford Co., Richland, WA (USA)). Jan 1989. Contract AC06-87RL10930. 8p. (CONF-890207—15). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008808/JAW.

From Waste management '89; Tucson, AZ, USA (26 Feb 1989).

Successful implementation of the Resource Conservation and Recovery Act (RCRA) at the Hanford Site has been and will continue to be a significant challenge. The 560 square mile Site encompasses over a thousand facilities and waste sites that are influenced by the complex and changing regulatory framework of RCRA. The challenge is enhanced by the relatively new application of RCRA to mixed waste, which contains both radionuclides and hazardous constituents. This paper provides an overview of the approaches being used to achieve and maintain compliance.

21828 **Localized corrosion and stress corrosion cracking of austenitic candidate materials for high-level radioactive waste disposal containers.** Halsey, W.G.; Farmer, J.C.; McCright, R.D.; Von Konyneburg, R.A.; Bullen, D.B. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

Three austenitic alloys are being considered as candidate materials for fabrication of high-level radioactive waste containers. Waste will include fuel assemblies from reactors, as well as borosilicate glass forms, and will be sent to the Yucca Mountain site in Nevada for disposal. The containers must maintain mechanical integrity for 50 years and substantially complete containment for 300-1000 years. Radioactive decay of the radionucleides will result in substantial heat generation and fluences of gamma radiation. Materials may undergo any of several modes of degradation in this environment, including atmospheric oxidation, uniform aqueous phase corrosion, pitting, crevice corrosion, sensitization and intergranular stress corrosion cracking (IGSCC), and transgranular stress corrosion cracking (TGSCC). This paper is an analysis of relevant pitting, crevice corrosion, and stress corrosion cracking (SCC) data.

21829 **Incineration systems for low level and mixed wastes.** Vavruska, J. (Los Alamos National Lab., PO Box 1663, MS E517, Los Alamos, NM (US)). pp v of Incineration of low level and mixed wastes: 1986. Irvine, CA; Univ. of California at Irvine (1986). (CONF-860429—).

From 5. annual conference and exhibit on the incineration of low-level radioactive waste; Charlotte, NC, USA (23 Apr 1986).

A variety of technologies has emerged for incineration of combustible radioactive, hazardous, and mixed wastes. Evaluation and selection of an incineration system for a particular application from such a large field of options are often confusing. This paper presents several current incineration technologies applicable to Low Level Waste (LLW), hazardous waste, and mixed waste combustion treatment. The major technologies reviewed include controlled-air, rotary kiln, fluidized bed, and liquid injection. Coupled with any incineration technique is the need to select a compatible offgas effluent cleaning system. This paper also reviews the various methods of treating offgas emissions for acid vapor, particulates, organics, and radioactivity. Such effluent control systems include the two general types - wet and dry scrubbing with a closer look at quenching, inertial systems, fabric filtration, gas absorption, adsorption, and various other filtration techniques. Selection criteria for overall waste incineration systems are discussed as they relate to waste characterization.

21830 **Performance assessment of refractory samples in the Los Alamos controlled air incinerator.** Hutchins, D.; Borduin, L.; Koenig, R.; Vavruska, J.; Warner, C. (Los Alamos National Lab., Waste Management Group, Los Alamos, NM (US)). pp v of Incineration of low level and mixed wastes: 1986. Irvine, CA; Univ. of California at Irvine (1986). (CONF-860429—).

From 5. annual conference and exhibit on the incineration of low-level radioactive waste; Charlotte, NC, USA (23 Apr 1986).

A refractory evaluation project was initiated in 1979 to study the performance of six selected refractory materials within the Los Alamos Controlled Air Incinerator (CAI). Determining refractory resistance to thermal shock, chemical attack, and plutonium uptake was of particular interest. The experimental refractories were subjected to a variety of waste materials, including transuranic (TRU) contaminated wastes, highly chlorinated compounds and alkaline metal salts of perchlorate, chlorate, nitrate and oxylate, over the six year period of this study. Results of this study to date indicate that the use of high alumina, and possibly specialty plastic

refractories, is advisable for the lining of incinerators used for the thermal destruction of diverse chemical compounds.

21831 **ORGDP RCRA/PCB.** Rodgers, T. (Oak Ridge Gaseous Diffusion Plant, Oak Ridge, TN (US)). pp v of Incineration of low level and mixed wastes: 1986. Irvine, CA; Univ. of California at Irvine (1986). (CONF-860429—).

From 5. annual conference and exhibit on the incineration of low-level radioactive waste; Charlotte, NC, USA (23 Apr 1986).

A dual purpose solid/liquid incinerator is currently being constructed at the Oak Ridge Gaseous Diffusion Plant [ORGDP (K-25)] to destroy uranium contaminated, hazardous organic wastes in compliance with the Toxic Substances Control Act (TSCA) and the Resource Conservation and Recovery Act (RCRA). These wastes are generated by the gaseous diffusion plants in Oak Ridge, TN; Paducah, KY; and Portsmouth, OH. In addition, waste will also be received from the Y-12 Plant, Oak Ridge National Laboratory (ORNL), and the Feed Materials Production Center (FMPC). Destruction of PCBs and hazardous liquid organic wastes will be accomplished in a rotary kiln incinerator with an afterburner. This system was selected after a study of various alternatives which are covered in Report No. X-OE-141. Incineration was chosen because it is dependable, permanent, detoxifies organics, and reduces volume. The rotary kiln incinerator was selected because it can thermally destroy organic constituents of liquids, solids, and sludges to produce an organically inert ash. The incineration system, off-gas treatment system, and related instrumentation and controls are being provided by International Waste Energy Systems (IWES) which is responsible for design, construction, startup, and performance testing.

21832 **Hydrothermal interaction of solid wafers of topopah spring tuff with ground water and distilled water at 90°C, 150°C and 250°C using dickson-type, gold-bag rocking autoclaves.** Knauss, K.G.; Beiriger, W.J.; Peifer, D.W.; Piwinskii, A.J. (Lawrence Livermore National Lab., CA (USA)). *Geological Society of America, Abstracts with Programs;* **17**: 630(1985). (CONF-8510489—). Contract W-7405-ENG-48.

From 98. annual meeting of the Geological Society of America; Orlando, FL, USA (28 Oct 1985).

Experiments were conducted to study the hydrothermal interaction of rock and water representative of a potential high-level waste repository at Yucca Mountain, Nevada. All experiments were run in Dickson-type, gold-bag rocking autoclaves that were periodically sampled under in-situ conditions. A total of nine short-term (up to 66d) experiments were run covering the range 90°C to 250°C and 50b to 100b. The evolving fluid composition was closely monitored. Pre- and post-test characterization of the reacting materials was extensive and post-test identification and chemical analysis of secondary phases resulting from hydrothermal interactions was aided by using monoliths of tuff rather than crushed material. At all three temperatures dissolved silica was limited to cristobalite solubility. At 250°C secondary minerals were dominantly zeolites (dachiardite and mordenite) with minor amounts of a poorly crystalline, K-bearing clay-like phase and a pure silica phase (probably cristobalite). Run products at 150°C were less well developed, less crystalline and far less abundant. At 90°C only minor evidence for dissolution of the primary crystalline phases was observed and no run products were seen. The empirical results obtained here have been used to check/confirm the modeled results produced by calculations using the geochemical reaction progress code EQ3/6.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 21757, 21758, 21770, 21777, 21778, 21779, 21784, 21797, 21799, 21800, 21801, 21803, 21805, 21812, 21813, 21814, 21815, 21816, 21817, 21818, 21819, 21820, 21823, 21824, 21826, 21827, 21829, 21831, 21837, 23106, 23107

21833 **(INIS-GB—178) Annual report on radioactive discharges and monitoring of the environment 1987.** (British Nuclear Fuels plc., Risley. Health and Safety Directorate). 1988. 134p. NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS. Order Number DE88706054/JAW.

This Annual Report covers BNFL operations, and waste storage and disposal and monitoring at and around Sellafield, Drigg, ChapelCross, Springfields and Capenhurst.

21834 **(NUREG/CR—3037) A computer code to estimate accidental fire and radioactive airborne releases in nuclear fuel cycle facilities: User's manual for FIRIN.** Chan, M.K.; Ballinger, M.Y.; Owczarski, P.C. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety; Pacific Northwest Lab., Richland, WA (USA)). Feb 1989. Contract AC06-76RL01830. 196p. (PNL—4532). NTIS, PC A09 - GPO - OSTI. Order Number TI89008231/JAW.

This manual describes the technical bases and use of the computer code FIRIN. This code was developed to estimate the source term release of smoke and radioactive particles from potential fires in nuclear fuel cycle facilities. FIRIN is a product of a broader study, Fuel Cycle Accident Analysis, which Pacific Northwest Laboratory conducted for the US Nuclear Regulatory Commission. The technical bases of FIRIN consist of a nonradioactive fire source term model, compartment effects modeling, and radioactive source term models. These three elements interact with each other in the code affecting the course of the fire. This report also serves as a complete FIRIN user's manual. Included are the FIRIN code description with methods/algorithms of calculation and subroutines, code operating instructions with input requirements, and output descriptions. 40 refs., 5 figs., 31 tabs.

21835 **(PNL-SA—15238) Monitoring fish, wildlife, radionuclides and chemicals at Hanford, Washington.** Gray, R.H. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1989. Contract AC06-76RL01830. 13p. (CONF-890282—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008251/JAW.

From 4. biennial symposium: issues and technology in the management of impacted wildlife; Glenwood Springs, CO, USA (6 Feb 1989).

Concern about the effects of potential releases from nuclear and non-nuclear activities on the US Department of Energy's Hanford Site in southeastern Washington has evolved over four decades into a comprehensive environmental monitoring and surveillance program. The program includes field sampling, and chemical and physical analyses of air, surface and ground water, fish, wildlife, soil, foodstuffs, and natural vegetation. In addition to monitoring radioactivity in fish and wildlife, population numbers of key species are determined, usually during the breeding season. Data from monitoring efforts are used to assess the environmental impacts of Hanford operations and calculate the overall radiological dose to humans onsite, at the Site perimeter, or residing in nearby communities. Chinook salmon (Oncorhynchus tshawytscha) spawning in the Columbia River at Hanford has increased in recent years with a concomitant increase in winter nesting activity of bald eagles (Haliaeetus leucocephalus). An elk (Cervus elaphus) herd, established by immigration in 1972, is also increasing. Nesting Canada goose (Branta canadensis) and great blue heron (Ardea herodias), and various other animals, e.g., mule deer (Odocoileus hemionus) and coyotes (Canis latrans) are common. Measured exposure to penetrating radiation and calculated radiation doses to the public are well below applicable regulatory limits. 35 refs., 4 figs.

0540 Health And Safety

REFER ALSO TO CITATION(S) 21769, 21814, 21834, 22072, 23048, 23243

21836 **(CONF-890207—14) Department of Energy Defense Programs Environmental Restoration Program update.** Lehr, J.C.; Eyman, L.D.; Thompson, W.W. Jr. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008232/JAW.

From Waste management '89; Tucson, AZ, USA (26 Feb 1989).

Federal facilities are under increasing pressure to remediate inactive hazardous waste sites and associated off-site areas. The Superfund Amendments and Reauthorization Act federal facilities provision requires that the Environmental Protection Agency establish a public docket to list all federal sites contaminated by hazardous wastes or substances and to monitor the progress of investigations and cleanups against an established schedule. In addition, the

Resource Conservation and Recovery Act requires that operating permits for hazardous waste treatment, storage, and disposal facilities be issued only upon binding agreements that identify specific schedules for corrective action for all hazardous waste releases that have or are occurring at the facility. Defense Programs (DP) must make remedial actions integral to its mission. Environmental clean-ups are given increased emphasis with the new regulations/laws providing the right to private citizens and the states to sue to enforce these statutes and schedule commitments. 1 fig., 2 tabs.

21837 (DOE/OR/21548—051-Rev.0) Chemical soil data report to support interim response actions, construction staging area, and Administration Building: Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri: Revision 0. (MK-Ferguson Co., Weldon Spring, MO (USA); Jacobs Engineering Group, Inc., St. Charles, MO (USA)). Feb 1989. Contract AC05-86OR21548. 104p. NTIS, PC A06 - OSTI. Order Number DE89008418/JAW.

Five activities are planned to improve environmental conditions or to improve facilities at the Weldon Spring Site. Each activity must be evaluated for potential environmental impacts. Chemical soil contamination was potentially present in each affected area. A sampling program was designed and implemented to evaluate chemical soil conditions. Samples were analyzed for nitroaromatic compounds, metals, inorganic anions, semi-volatile and volatile organic compounds, pesticides, and PCBs. This investigation documented low concentrations of semi-volatile organic compounds, pesticides, PCBs and nitroaromatics. Higher concentrations of nitrate, sulfate and some metals were also detected. The contaminants detected are consistent with past operations at the WSS. The concentrations of contaminants do not significantly impact the proposed activities. Data from this investigation has been incorporated into the planning and documentation activities for each activity.

21838 (INIS-GB—169) Statement on incidents at nuclear installations - first quarter 1988. (Health and Safety Executive, London (UK)). 28 Sep 1988. 6p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706171/JAW.

Six incidents were reported in the first quarter of 1988. Four occured at the Sellafield nuclear reprocessing plant. In two separate incidents workers were cut by retaining clips and received doses of radiation to bone surface marginally in excess of the annual dose limit. Two other workers received doses in excess of the annual limit, one when carrying out analytical work inside a ventilated compartment, the other while working in a processing cubicle. Investigations were carried out into all incidents. Following one of the incidents the Nuclear Installations Inspectorate has asked British Nuclear Fuels (BNFL) to carry out an inquiry into the Research and Development Department's procedures for the protection of personnel. At the Torness Nuclear power station it was found in February that some (11 out of 352) of the nuts securing the end closure plates of the circulator penetrations on Reactor 1 were insufficiently tight. No gas leaked and the consent to raise power was given in March. However, the procedures for bolt tightening will be reviewed. The sixth incident concerned contaminated soil at a railhead in Bridgewater, Somerset due to contamination from fuel transport flasks over 20 years. The soil was removed. (U.K.).

21839 (INIS-GB—177) Annual report on occupational safety 1987. (British Nuclear Fuels plc., Risley. Health and Safety Directorate). 1988. 16p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705767/JAW.

This report presents detailed information on occupational safety relating to the Company's employees for 1987. Data are quoted in tables and text, together with data from the previous year for comparison where available. The report is presented under the following headings: radiological and non-radiological safety, incidents, appendices (statutory dose limits, nuclear incident criteria for reporting to ministers).

21840 (INIS-GB—179) Health and safety annual report 1987. (British Nuclear Fuels Ltd., Risley). 1988. 28p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705768/JAW.

The principal activities and organisation of BNFL are reviewed in relation to the impact these activities have on the workforce, members of the general public and the environment, together with services for occupational safety within the company.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 21746, 22796

21841 (SAAS—364) Actinide content of spent fuel assemblies of WWER-1000 type. Moeller, W.; Burmester, M. (VEB Kombinat Kraftwerksanlagenbau, Berlin (German Democratic Republic); Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1988. 79p. NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88706273/JAW.

For purposes of national and international nuclear material safeguards this report provides for the first time the course of loss and production in terms of weight of the relevant actinide nuclides for all 10 types of WWER-1000 fuel assemblies up to mean burnup values of maximally 60 GWd/tU, and illustrates the source data, the computation method and the results. Moreover the investigations scheduled to be carried on have been discussed dealing with the validation of results, the determination of passive neutron emission and the parametrization of influence factors. 12 figs., 20 tabs.

21842 (WHC-SA—0062) Reducing waiting time at security checkpoints. Landauer, E.G.; Becker, L.C. (Westinghouse Hanford Co., Richland, WA (USA)). Aug 1988. Contract AC06-87RL10930. 19p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008705/JAW.

The authors were asked to improve the time it took a queue of cars to go through a security gate every morning and afternoon. Each individual passing through the gate was required to show a security badge to a guard. The goal was to improve processing time and to eliminate a safety problem at the gate without increasing the required resources. This problem required quick resolution. The project was initiated using queuing theory. After collecting data, the authors determined that a simulation model would be more appropriate. The study demonstrated that a significant improvement could be seen when the same number of guards worked two parallel traffic lines leading to the single gate, in place of the security guards working in a serial process from a single line of traffic. 7 tabs., 4 figs.

21843 Coping with subjectivity in vulnerability assessment. Renis, T.A.; Cardwell, R.G. (Lawrence Livermore National Lab., Livermore, CA (US); Martin Marietta, Oak Ridge, TN (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 105-111(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Vulnerability assessment models are widely used to systematically evaluate the performance of complex safeguards systems against a variety of threats. These models require varying levels of detail and input data about the physical design of a facility and its safeguards operations and procedures. However, to evaluate safeguards effectiveness and give a performance rating, these models require additional performance data reflecting probabilities of detection, assessment, interruption, and neutralization, as well as the associated times for various adversary scenarios. These data may be attained from equipment design specifications, laboratory testing, expert judgment, or component testing. Regardless of how these data are obtained, they are inherently subjective. This paper addresses the uses of various vulnerability assessment models and the nature of subjectivity in those models. The paper also describes methods for coping with subjective data.

21844 **Methods for cost-benefit-risk analysis of material-accounting upgrades.** Fishbone, L.G.; Gordon, D.M.; Higinbotham, W.; Keisch, B. (Technical Support Organization, Brookhaven National Lab., Upton, NY (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 92-100(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

The authors have developed a cost-benefit-risk methodology for evaluating material-accounting upgrades at key measurement points in nuclear facilities. The focus of this methodology is on nuclear-material measurements and their effects on inventory differences and shipper/receiver differences. The methodology has three main components: cost, benefits, and risk factors. The fundamental outcome of the methodology is therefore cost-benefit ratios characterizing the proposed upgrades, with the risk factors applied as necessary to the benefits. Examples illustrate the methodology's use.

21845 **Demonstration personnel and material tracking system at ANL-W.** Roybal, J.A.; Ortiz, S.; Henslee, S.P. (Sandia National Labs., Albuquerque, NM (US); Argonne National Lab., West Idaho Falls, ID (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 789-793(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

A Personnel and Material Tracking System (PMTS) was demonstrated in the Fuel Manufacturing Facility (FMF) at Argonne National Laboratories-West (ANL-W) in July, 1987. The PMTS is intended to aid in the transfer of inventory materials from area to area within a facility such as FMF. It is also intended to assure that only those personnel who are authorized to do so may conduct these transfer operations. The PMTS Personnel Movement (PM) subsystem uses portals installed between areas to alert the system to the movement of personnel between areas. The portals are composed to two sensors, one on either side of a proximity badge reader, to detect the presence of personnel entering the portal area. However, a restricted area can be assigned to any badge holder which will cause the system to issue an alert if the badge holder passes into his/her restricted area. The PM subsystem is intended to be transparent when in use. The PMTS Inventory Material Access (IMA) subsystem provides two functions: material control and material access. The material control is provided by the Wireless Alarm Transmission of Container Handling (WATCH) system which is a sensor rf transmitter system that detects item movements. Material access is provided by the Mobile Accountability Verification Inventory Station (MAVIS) system which is a self-powered smart barcode reader.

21846 **Training needs assessment.** Rector, W.K. (U.S. Dept. of Energy Central Training Academy, Albuquerque, NM (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 919-921(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

The one basic requirement which all educators and trainers agree upon as the basis for training is the need. A training need may be described as existing anytime an actual condition differs from a desired condition. In other words, when an employee fails to perform a task according to that person's job description, a training need is established. The training needs assessment process will identify the specific training required to perform a specific, desired task. Training needs must be identified, objectives written and appropriate curriculum developed which targets the specific needs of a job, unit or organization before one can truly say they they have a valid, cost-effective training program. A needs assessment is, therefore, paramount to and the foundation of the training process. The purposes of a training needs assessment are to: 1) Provide a deliberate and orderly process for planning and developing training programs which ensure instructional needs and objectives are met; and 2) Assure that personnel are taught, in a cost-effective way, the knowledge, skills and abilities essential to successful task performance.

21847 **Exterior field evaluation of new generation video motion detection systems.** Malone, T.P. (Sandia National Labs., Albuquerque, NM (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 750-759(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Recent advancements in video motion detection (VMD) system design and technology have resulted in several new commercial VMD systems. Considerable interest in the new VMD systems has been generated because the systems are advertised to work effectively in exterior applications. Previous VMD systems, when used in an exterior environment, tended to have very high nuisance alarm rates due to weather conditions, wildlife activity and lighting variations. The new VMD systems advertise more advanced processing of the incoming video signal which is aimed at rejecting exterior environmental nuisance alarm sources while maintaining a high detection capability. This paper discusses the results of field testing, in an exterior environment, of two new VMD systems.

21848 **Information exchange - DOE oversight programs.** Tubbs, D.C.; Field, H.C. (U.S. Dept. of Energy, Germantown, MD (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 605-610(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Oversight programs are conducted by the U.S. Department of Energy to review activities carried out by field and contractor organizations. Two of these oversight programs focus on safeguards and security and on safety and health activities. These two programs are independent, but share many common objectives and review techniques. The mutual potential benefit was recognized from an exchange of information on review techniques. The first step in this exchange was the participation by an Office of Security Evaluations (OSE) staff member with the Office of Nuclear Safety (ONS) during their planning, conduct and reporting of a Technical Safety Appraisal (TSA). This paper briefly describes the OSE and ONS programs. It also identifies and analyzes the similarities and differences of the two programs. The purpose of this paper is to provide perspectives on the approach taken, the techniques used and the differences between two oversight programs conducted by the Department of Energy.

21849 **International safeguards applications for the WATCH system.** Drayer, D.D.; Sonnier, C.; Ystesund, K. (Sandia National Labs., Albuquerque, NM (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 690-693(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

The Wireless Alarm Transmission of Container Handling (WATCH) System, which was described in a previous INMM paper, was initially developed for domestic security use, within vaults or storage areas containing many discrete items. The system is composed of remote transmitters and a central receiver. With some modifications the WATCH System could be used in a variety of International Safeguards applications. This paper describes the potential applications and what changes would be required, including enclosure of the transmitters within a tamper resistant container, one-way authentication of the transmitted messages, and improved data presentation.

21850 **The second US/FRG workshop on near-real-time accounting for reprocessing plants.** Hakkila, E.A.; Gutmacher, R.G.; Weh, R. (Los Alamos National Lab., Los Alamos, NM (US); Fuer Wiederaufarbeitung von Kernbrennstoffem mbH, Hannover (DE)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 883-886(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

The second technical workshop on near-real-time accounting in an industrial scale reprocessing plant was held from Decemter 7-9, 1987 in Los Alamos. The workshop was organized within the context of the US/DOE-FRG/BMFT agreement in the field of

international safeguards. The workshop was initiated by the Los Alamos National Laboratory and the DWK, which has responsibility for construction and operation of a planned industrial scale reprocessing plant in the FRG. The workshop objective was to review current state-of-the-art in near-real-time accounting and to develop a common understanding among experts from the participating countries to identify problems requiring additional work.

21851 **Measuring the safeguards value of material accountability.** Sicherman, A. (Lawrence Livermore National Lab., P.O. Box 808, L-195, Livermore, CA (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 86-91(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Material accountability (MA) activities focus on providing after-the-fact indication of diversion or theft of special nuclear material (SNM). MA activities include maintaining records for tracking nuclear material and conducting periodic inventories and audits to ensure that loss has not occurred. This paper presents a value model concept for assessing the safeguards benefits of MA activities and for comparing these benefits to those provided by physical protection (PP) and material control (MC) components. The model considers various benefits of MA, which include: 1) providing information to assist in recovery of missing material, 2) providing assurance that physical protection and material control systems have been working, 3) defeating protracted theft attempts, and 4) properly resolving causes of and responding appropriately to anomalies of missing material and external alarms (e.g., hoax). Such a value model can aid decision-makers in allocating safeguards resources among PP, MC, and MA systems.

21852 **Protection planning and risk management at Lawrence Livermore National Laboratory.** Hunt, J.S.; Altman, W.D.; Hockert, J.W. (Lawrence Livermore National Lab., Livermore, CA (US); ERC International, Albuquerque, NM (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 257-260(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Effective safeguards and security management begins with comprehensive strategic planning that synthesizes protection objectives, threat information, existing protection capabilities, consequences of protection failure, and the costs and impacts of safeguards changes into cost effective protection strategies that adequately address credible threats. Lawrence Livermore National Laboratory (LLNL) has developed a structured risk management approach to safeguards and security planning that is designed to lead to protection strategies that are cost effective, meet the intent of Department of Energy (DOE) orders, balance protection needs with programmatic priorities, and acknowledge a level of residual risks that is not cost effective to eliminate. This risk management approach to safeguards decision making was used to develop the first DOE-approved Master Safeguards and Security Agreement (MSSA) that addresses all security interests at a major facility including: special nuclear material, classified information and materials, computer and communication security, and other DOE property. This risk management approach also provides the strategic basis for day-to-day management of the LLNL security program as well as the integration of safeguards program upgrades.

21853 **Testing TRANSCOM - U.S. Department of Energy's radmat tracking system.** Carlson, R.D.; Koehl, E.R.; Harmon, L.H.; Habib, E.J.; Mignone, T.A.; Dutt, S. (Argonne National Lab., Argonne, IL (US); United States Dept. of Energy, Germantown, MD (US); Systems Research and Applications, Corp., Arlington, VA (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 627-635(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

A transportation tracking system has been developed by the Department of Energy (DOE) in response to three institutional concerns about shipments of large quantities of radioactive materials: routing, prenotification, and emergency response. This tracking system consists of a location system, a communication system with the carrier, and an information management system which appropriately distributes shipment information to DOE headquarters, field offices, and key state officials. The DOE prototype system developed for this purpose is called TRANSCOM. This paper presents some of the tests that have been performed to demonstrate that LORAN-C is acceptable as a location system for TRANSCOM, and that satellite communications techniques can provide timely results regarding location and communication with carrier vehicles.

21854 **Federal databases.** Welch, M.J.; Welles, B.W. (Pacific Nuclear Systems, Technical Services, Fairfax, VA (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 328-333(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Accident statistics on all modes of transportation are available as risk assessment analytical tools through several federal agencies. This paper reports on the examination of the accident databases by personal contact with the federal staff responsible for administration of the database programs. This activity, sponsored by the Department of Energy through Sandia National Laboratories, is an overview of the national accident data on highway, rail, air, and marine shipping. For each mode, the definition or reporting requirements of an accident are determined and the method of entering the accident data into the database is established. Availability of the database to others, ease of access, costs, and who to contact were prime questions to each of the database program managers. Additionally, how the agency uses the accident data was of major interest.

21855 **Overview of the U.S. Department of Energy master safeguards and security agreement program.** Billings, M.P.; Duncan, M.R.; Craig, J.R. (Westinghouse Hanford Co., Richland, WA (US); U.S. Dept. of Energy, Headquarters Germantown, MD (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 19-26(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

The Master Safeguards and Security Agreement establishes a contract between the U.S. Department of Energy-Headquarters and a U.S. Department of Energy regional Operations Office regarding protection strategies, protection system performance, and acceptability of risks for U.S. Department of Energy Safeguards and Security interests at a facility or site. An approved Master Safeguards and Security Agreement defines the protection system performance baseline for evaluations, inspections, and audits, and can introduce exceptions to U.S. Department of Energy orders.

21856 **A testbed for advanced MC and A concepts.** Tisinger, R.M. (Safeguards Systems Group, Los Alamos National Lab., Los Alamos, NM (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 315-318(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Advanced concepts in materials control and accounting include distributed databases in a distributed processing environment and on-line instrumentation. To test various ideas in this area, the authors developed a testbed consisting of three personal computers (PCs) with several input devices and suitable software. The principal design aspects being tested include database structure, communication between various network nodes, data-base update on the host, speed of transaction processing, data input from on-line instrumentation, data input from on-line instrumentation, and a user-friendly interface with the operator. An IBM PC/XT at the local level is used to collect data using a barcode reader and balance in a mockup glove box. These represent typical examples of simple on-line instrumentation in nuclear material facilities. Custom software is called PC/DYMAC, a materials accounting package developed by Robert Bearse in cooperation with Argonne National Laboratory-West under the direction and funding of the Los Alamos Safeguards research and development program. It was developed using dBaseIII PLUS but was compiled with foxBASE+ under the Santa Cruz Operations XENIX operating system.

21857 **A computer model for identifying security system upgrades.** Lamont, A. (Lawrence Livermore National Lab., Livermore, CA (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 264-269(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

This paper describes a prototype safeguards analysis tool that automatically identifies system weaknesses against an insider adversary and suggest possible upgrades to improve the probability that the adversary will be detected. The tool is based on this premise: as the adversary acts, he or she creates a set of facts that can be detected by safeguards components. Whenever an adversary's planned set of actions create a set of facts which the security personnel would consider irregular or unusual, we can improve the security system by implementing safeguards that detect those facts. Therefore, an intelligent computer program can suggest upgrades to the facility if we construct a knowledge base that contains information about: (1) the facts created by each possible adversary action, (2) the facts that each possible safeguard can detect, and (3) groups of facts which will be considered irregular whenever they occur together. The authors describe the structure of the knowledge base and show how the above information can be represented in it. They also describe the procedures that a computer program can use to identify missing or weak safeguards and to suggest upgrades.

21858 **The modular integrated video system (MIVS) program in perspective.** Schneider, S.L.; Sonnier, C.S.; Gaertner, K.J. (Sandia National Labs., Albuquerque, NM (US); International Atomic Energy Agency, Vienna (AT)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 887-890(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

A state-of-the-art video surveillance system, the Modular Integrated Video System (MIVS), has been developed by Sandia National Laboratories for the International Atomic Energy Agency (IAEA). The development of this system was sponsored by the U.S. Department of Energy and the U.S. Program of Technical Assistance to IAEA Safeguards. The development of the MIVS has followed, and continues to do so, a well-defined program plan. This paper revisits this program plan, including the completed development and initial production activities, the reliability testing currently in progress at the IAEA, and the other activities currently in progress leading to field evaluations and implementation. The lessons learned are highlighted.

21859 **Selection and evaluation of video tape recorders for surveillance applications.** Martinez, R.L. (Sandia National Labs., Albuquerque, NM (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 914-918(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Unattended surveillance places unique requirements on video recorders. One such requireemnt, extended operational reliability, often cannot be determined from the manufacturers' data. Subsequent to market surveys and preliminary testing, the Sony 8mm EVO-210 recorder was selected for use in the Modular Integrated Video System (MIVS), while concurrently undergoing extensive reliability testing. A microprocessor based controller was developed to life test and evaluate the performance of the video cassette recorders. The controller has the capability to insert a unique binary count in the vertical interval of the recorder video signal for each scene. This feature allows for automatic verification of the recorded data using a MIVS Review Station. Initially, twenty recorders were subjected to the accelerated lift test, which involves recording one scene (eight video frames) every 15 seconds. The recorders were operated in the exact manner in which they are utilized in the MIVS. This paper describes the results of the preliminary testing, accelerated life test and the extensive testing on 130 Sony EVO-210 recorders.

21860 **A new insider vulnerability assessment model.** Sokkappa, P.; Renis, T.A. (Lawrence Livermore National Lab., Livermore, CA (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 14-18(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

A new insider vulnerability assessment model is currently being developed at Lawrence Livermore National Laboratory (LLNL). The model focuses on timely detection of theft or diversion of nuclear material by a non-violent insider. This model will be part of an integrated vulnerability assessment package being developed jointly by LLNL and Sandia National Laboratory. The model will enable a safeguards analyst to complete a comprehensive and well-documented vulnerability analysis. Two major components are used in the model. The first consists of a description of the facility being analyzed, the safeguards components in the use at the facility, the theft material, and the potential insider adversaries. The second component is a predefined set of strategy definitions, including specific methods of defeating the individual safeguards components.

21861 **Overview of the integrated vulnerability assessment tool.** Al-Ayat, R.A.; Renis, T.A.; Matter, J.C.; Winblad, A. (Lawrence Livermore National Lab., Livermore, CA (US); Snadia National Labs., Albuquerque, NM (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 8-13(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Safeguards professionals need a single, comprehensive tool for evaluating safeguards effectiveness aginst theft of special nuclear material by many different adversaries: insiders, outsiders, and colluding insiders and outsiders. This paper describes a new integrated vulnerability assessment tool which is currently being tested and will be ready for release later this year. The tool consists of five modules: Integration System Manager, Facility Description, Insider Evaluation, Outsider Evaluation, and Collusion Evaluation. This tool provides a standard approach for evaluating safeguards effectiveness and for preparing Master Safeguards and Security Agreements at various DOE facilities.

21862 **Department of Energy's safeguards and security orders and guides.** Brown, R.W. (U.S. Dept. of Energy, Washington, DC (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 459-461(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

With the escalation of terrorism in the 1970's, the emphasis of the DOE's safeguards and security improvements has been on preventative physical protection-measures against outside adversaries. They have now progressed to a point where they are focusing on a revision of the graded safeguards approach and enhancing Material Control and Accountability. The key points addressed are the functions and responsibilities or organizational units in DOE Headquarters and at the field level, and significant features of the policy and procedures guides. Twenty-five DOE safeguards and security orders have undergone major revision.

21863 **Secure transmission of shipper/receiver confirmatory measurements.** Tisinger, R.M.; Brumfield, T. (Los Alamos National Lab., Los Alamos, NM (US); Oak Ridge Y-12 Plant, Oak Ridge, TN (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 123-125(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Shipper/receiver confirmatory measurements will be performed at Y-12 using equipment designed by Y-12 and the Safeguards Assay Group at Los Alamos. Equipment consists of three stationary NaI(T1) gamma-ray counter arrays and a Digital Equipment Corporation Micro-II processor for processing data. In the case of outgoing shipments, the counter data will be incorporated in a shipping file with other necessary documentation and transmitted to the intended recipient. In the case of incoming shipments,

this station will receive a similar file from the sending organization. Protection of all data at the S/RD Level is required.

21864 **Ose evaluation of delay systems in a high threat environment.** Rich, B.L.; Cook, B.G. (Office of Security Evaluations, U.S. Dept. of Energy, Washington, DC (US); Ronald E. Timm, R.E. Timm and Associates, Inc., Hinsdale, IL (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 577-580(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

The Office of Security Evaluations (OSE) has in place an Evaluation Program to assist the Department of Energy (DOE) Headquarters and operations office managers by assessing specific elements of protection programs and informing the managers of common strengths and weaknesses of these elements. This information is provided so that sufficient and cost effective protection programs are maintained or enhanced. The subject of this paper is the evaluation of delay systems in the high-threat environment defined for sensitive DOE security interests such as special nuclear materials, nuclear weapons, and related classified devices and information.

21865 **Integrated physical security system at the Savannah River Plant.** Meese, C.R.; Reeve, H.R. (E.I. du Pont de Nemours and Co., Aiken, SC (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 794-798(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

E.I. Du Pont de Nemours and Compnay, under contract to the Department of Energy, operates the Savannah River Plant for the production of defense nuclear materials. The site encompasses a fuel fabrication facility, three operating nuclear reactors, and two fuel processing facilities, which are separated by as much as 15 miles. A safeguards intrusion detection and access control system designed by Sandia National Laboratories, Albuquerque, has been in operation at the reactor sites starting in September of 1984. During that same time frame an analysis of the plant site determined the desirability of an integrated plant safeguards system encompassing all six noted facilities. This paper describes the integrated system architecture, which includes facility access control systems, entry control facilities, a plantwide access enrollment system, intrusion detection systems, area central alarm stations, a plantwide backup central alarm station, and an extensive safeguards communication system.

21866 **Simulation of a force on force exercise.** Terhune, R.; Van Slyke, D.; Sheppard, T.; Brandrup, M. (Lawrence Livermore National Lab., Livermore, CA (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 441-446(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

The Security Exercise Evaluation System (SEES) is under development for use in planning Force on Force exercises and as an aid in post-exercise evaluation. This study is part of the development cycle where the simulation results are compared to field data to provide guidance for further development of the model. SEES is an event-driven stochastic computer program simulating individual movement and combat within an urban terrain environment. The simulator models the physics of movement, line of sight, and weapon effects. It relies on the controllers to provide all knowledge of security tactics, which are entered by the controllers during the simulation using interactive color graphic workstations. They are able to develop, modify and implement plans promptly as the simulator maintains real time. This paper reports on how SEES will be used to develop an intrusion plan, test the security response tactics and develop observer logistics. A Force on Force field exercise will then be executed to follow the plan with observations recorded. An analysis is made by first comparing the plan and events of the simulation with the field exercise, modifying the simulation plan to match the actual field exercise, and then running the simulation to develop a distribution of possible outcomes.

21867 **Providing reliable equipment to IAEA through a low risk transition plan.** Green, L.; Weinstock, E.V.; Karlin, E.W. (Brookhaven National Lab., Upton, NY (US); Karlin Associates, PO Box 6706, Delray Beach, FL (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 347-350(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

The development and production of safeguards equipment is a complex process containing many potential pitfalls between the conceptual design and its implementation in the field. The conditions for equipment use are especially demanding. At the same time, the consequences of failure may be serious. Repeated failure may result in the loss of credibility of safeguards. Expensive back up measures such as re-verification of inventories may be required. Inspectors may come to distrust the equipment. Finally, the expense of maintaining the equipment may be excessive. It is therefore essential that the process for bringing equipment for the conceptual stage to actual routine use minimizes the risk of producing equipment that is unsuitable for the job. Fortunately, approaches for accomplishing this have already been developed in both the industrial and commercial sectors. One such approach, the Low Risk Transition Plan (LRTP) is described to show it can be applied to the production of reliable safeguards equipment.

21868 **Fencing intruders out.** Madsen, R.W. (Sandia National Labs., Albuquerque, NM (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 770-773(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Chain link fences are a component of almost every perimeter security system, and their use ranges from simply delineating a boundary to supporting sophisticated intrusion detectors. Standard chain link fences provide little delay, and often, fence-mounted sensors can be circumvented by using a lightweight ladder to jump over the fence with minimum fence disturbance. This investigation summarizes the results of approximately four hundred intrusions against several sensor combinations and fences from seven to twelve feet high. Fence climbing delays range from three to twenty seconds, depending on the fence and sensor combination used, and detection probabilities vary from low, in some cases, to very high for one configuration which has never been crossed without an alarm. A perimeter fence/barrier/sensor combination designed to delay and discourage intruders and provide for a high probability of detection is discussed as an end result of the investigation.

21869 **Robotic security vehicle for exterior environments.** Klarer, P.R.; Workhoven, R.M. (Advanced Technology Div., Sandia National Labs., Albuquerque, NM (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 534-537(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

This paper describes a current effort at Sandia National Labs to develop an outdoor robotic vehicle capable of performing limited security functions autonomously in a structured environment. The present stage of development entails application of algorithms originally developed for the SIR vehicle to a testbed vehicle more appropriate to an outdoor environment. The current effort will culminate in a full scale demonstration of autonomous navigation capabilities on routine patrol and teleoperation by a human operator for alarm assessment and response. Various schemes for implementation of the robot system are discussed, as are plans for further development of the system.

21870 **Changing the image of quality assurance in research and development.** Melroy, P.E. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 426-428(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

The traditional image of quality assurance (QA) in a research and development (R and D) institution has been that of paper work. QA was often perceived as focusing on documentation

rather than on contributions to productive work. The recent emphasis on regulation by outside groups and independent verification of QA systems has created an opportunity to reevaluate and change this image. The desired change is to create an understanding that when properly utilized, QA is essential to good project management and fully contributes to the success of technical programs. The change is being accomplished by sharpening the definition of QA systems of improved understanding by line organizations, developing a project QA in a structure that allows selective use of the NQA-1 standard, formation of a graded approach that simplifies QA for R and D projects, and an intense campaign to communicate the value of QA to laboratory personnel.

21871 **Protection program operations.** Jackson, K.H. (US Dept. of Energy - Richland Operations Office, Richland, WA (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 462-463(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Seven DOE Orders falling under the heading of "Protection Program Operations", have been issued with requirements that are sound, conservative, and applicable to the construction and maintenance of the DOE Safeguards and Security Program into the 1990's. The subtask group, formed under the Aquilina Task Force and assigned the responsibility for Protection Program Operations, was staffed with personnel from HQ Office of Safeguards and Security and from the Secuirty Divisions of Nevada, Idaho, and Richland Operations Offices. The subtask group worked from late April 1987 into October 1987 and a package of finalized Orders was transmitted to Mr. Aquilina by memorandum dated October 23, 1987.

21872 **The technical support organization at BNL is twenty years old.** Indusi, J.P. (Technical Support Organization, Brookhaven National Lab., Upton, NY (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 799-801(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

The Technical Support Organization was established by the Atomic Energy Commission in January 1968 at Brookhaven National Laboratory (BNL). The original idea came from a small group of scientists at BNL. The group included Willy Higinbotham, Herb Kouts, Frank Miles, Richard Dodson, and Gerhardt Friedlander. The AEC endorsed the idea of a technical support group to provide technical assistance to AEC's Office of Safeguards and Materials Management and they sent requests for expressions of interest throughout the complex. For a number of reasons, to be discussed in the paper, the Technical Support Organization was established at BNL. An early project was the Conceptual Design for Safeguarding Nuclear Material which formed the first logical and systematic description of the integration of several elements into a safeguards system for protecting nuclear materials. Many other projects were undertaken over the years. TSO today provides technical assistance to the DOE Office of Safeguards and Secuirty, the Office of Classification and Technology Policy, and the Office of Security Evaluations. Technical support to the IAEA is provided under the Program of Technical Assistance to Agency Safeguards (POTAS). Recently, TSO began a program of technical assistance to the Air Force Weapons Laboratory in the area of nuclear systems security.

21873 **Security training with interactive laser-video-disk technology.** Wilson, D. (DOE Central Training Academy, Albuquerque, NM (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 432-433(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

DOE, through its contractor EG and G Energy Measurements, Inc., has developed a state-of-the-art interactive-video system for use at the Department of Energy's Central Training Academy. Called the Security Training and Evaluation Shooting System (STRESS), the computer-driven decision shooting system employs the latest is laservideo-disk technology. STRESS is designed to provide realistic and stressful training for security inspectors employed by the DOE and its contractors. The system uses wide-screen video projection, sophisticated scenario-branching technology, and customized video scenarios especially designed for the DOE. Firing a weapon that has been modified to shoot "laser bullets," and wearing a special vest that detects "hits": the security inspector encounters adversaries on the wide screen who can shoot or be shot by the inspector in scenarios that demand fast decisions. Based on those decisions, the computer provides instantaneous branching to different scenes, giving the inspector confrontational training with the realism and variability of real life.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 21827, 21854, 21867, 21872, 22072, 22074, 22302, 22303, 22304, 22305, 22306, 22307, 22795, 22796

21874 **(CEA-DAS—556) Regulations and the problems of their implementation in UF6 transport.** Devillers, C.; Grenier, M.; Ringot, C.; Warniez, P.; Blum, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete; Transnucleaire, 75 - Paris (France)). (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Dec 1988. 5p. (CONF-880558—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757348/JAW.

From Uranium hexafluoride--safe handling, processing, and transporting conference; Oak Ridge, TN, USA (24 May 1988).

UF/sub 6/ is currently transported in packagings which were developed in the sixties - standardized and used all over the world, these packagings perform their duty adequately. Nevertheless, the growing amounts of UF/sub 6/ and the changes in the regulations now raises the problem of compliance of these packagings with the latter. The problems which deserve special attention are: selection of the packaging type in terms of the origin and the enrichment, design of valve covers, behaviour at low temperatures, regulatory requirements in handling, tying down cleaning and unloading, allowable dose rate increase in case of minor mishaps, behaviour in fire, taking into account the toxicity, identification of special features required in the case of controlled moderation of fissile packages, transport conditions of empty packagings containing heels. In this paper are reviewed the results of this analysis, which is limited to the case of transport using cylinders of 48Y and 30B.

21875 **(CP—15) Medical surveillance according to the resolution radiation protection nuclear-power-law in working with ionizing radiation. Concept publication.** (Ministerie van Sociale Zaken en Werkgelegenheid, The Hague (Netherlands). Arbeidsinspectie). 1988. 42p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706142/JAW.

The rules with regard to the medical surveillance of persons who, during the execution of their duties, may be exposed to certain amounts of ionizing radiation are treated. After an explanation of the general starting points of the policy with regard to radiation hygiene, two governing tools are reviewed: the set of licences and the radiation hygiene standards. 10 refs.; 1 table.

21876 **(INIS-XN—154) Decree of the President of the Council of Ministers, 10 August 1988, No. 377, providing for the regulation of environmental compatibility in accordance with Section 6 of Act No. 349 of 8 July 1986 concerning the Ministry of the Environment and regulations in the field of environmental damage.** (International Atomic Energy Agency, Vienna (Austria)). 31 Aug 1988. 6p. (In Italian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706181/JAW.

Published in the Gazzetta Ufficiale della Republica Italiana No. 204.

This Decree concerns the compatibility of industrial installations and equipment - both public and private - with environmental protection. The Decree entered into force on the day following its publication. It specifies the conditions for performing environmental impact assessments and the information to be provided at the planning stage of the installations involved. Those include nuclear power plants and other reactors. The Decree further provides that

facilities for the final storage and disposal of radioactive waste also require an environmental impact assessment. (NEA).

21877 **(INIS-XN—163) Ordinance on definitions and licenses in the atomic energy field - Amendment of 2 March 1987.** (International Atomic Energy Agency, Vienna (Austria)). 2 Mar 1987. 1p. (In French). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706190/JAW.

The amendment to the Ordinance of 18 January 1984, aims essentially at ensuring that the commitments under the Treaty on the Non-Proliferation of Nuclear Weapons are complied with in Switzerland. The goods and articles involving uranium enrichment by the gas centrifuge process and nuclear fuel reprocessing having been specified by the competent international bodies, are mentioned in the Ordinance. Henceforth, they are included in the goods subject to notification or licensing listed in the Annex to the Ordinance. Also for non-proliferation purposes, the licensing requirement has been extended to the transit of so-called sensitive goods when they have been assigned elsewhere in Switzerland. The basis in both cases is the 1959 Atomic Energy Act, as amended in 1986 in respect of import and export of nuclear articles and technology. The amendment entered into force on 1 April 1987.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

21878 (INIS-BR—1440, pp 44) **Concept and implementation of /sup 67/Ga production process engineering.** Almeida, G.L. de. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

21879 (INIS-BR—1440, pp 46) **Logical system for /sup 67/Ga production process management and control.** Almeida, G.L. de. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

21880 (INIS-BR—1440, pp 69) **Production of /sup 57/Co source.** Santos, D.F. dos; Osso Junior, J.A.; Silva, R.F. da; Souza, A.S.F. de. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

21881 (ZfI-Mitt—139, pp 15-33) **Enrichment of krypton 85 by thermal diffusion.** Mueller, G.; Zahn, H.; Meier, A.; Eckert, B.; Riemenschneider, J.; Sobottka, A.; Zieger, K.; Schulze, H.; Engel, S.; Roecker, J. Jul 1988. (In German). NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS. Order Number DE88706276/JAW.

In 1987 scientific report of the Central Institute for Isotope and Radiation Research.

The enrichment of krypton 85 starting from fission-waste krypton gas by means of a thermal diffusion cascade is described, especially the constructional scheme, dimensions, performance, and process control, as well as radiation protection measures applied. Non-stationary and equilibrium concentration distributions, both calculated and measured, are presented. Possibilities for higher enrichment of /sup 85/Kr.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 22729, 23203, 23243, 23867

21882 **(CONF-890408—7) Geometrical shape optimization of a cold neutron source using artificial intelligence strategies.** Azmy, Y.Y. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006426/JAW.

From Advances in nuclear engineering computation and radiation shielding; Santa Fe, NM, USA (9 Apr 1989).

A new approach is developed for optimizing the geometrical shape of a cold neutron source to maximize its cold neutron outward leakage. An analogy is drawn between the shape optimization problem and a state space search, which is the fundamental problem in Artificial Intelligence applications. The new optimization concept is implemented in the computer code DAIT in which the physical model is represented by a two group, r-z geometry nodal diffusion method, and the state space search is conducted via the Nearest Neighbor algorithm. The accuracy of the nodal diffusion method solution is established on meshes of interest, and is shown to behave qualitatively the same as transport theory solutions. The dependence of the optimum shape and its value on several physical and search parameters is examined via numerical experimentation. 10 refs., 6 figs., 2 tabs.

21883 **(CONF-8904120—1) International cooperative effort to establish dosimetry standardization for radiation processing.** Farrar, H. IV. (Rockwell International Corp., Canoga Park, CA (USA)). 1989. Contract AP04-88AL53385. 4p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007403/JAW.

From 7. international meeting on radiation processing; Noordwijkerhaut, Netherlands (23 Apr 1989).

Radiation processing is a rapidly developing technology with numerous applications in food treatment, sterilization, and polymer modification. The effectiveness of the process depends, however, on the proper application of dose and its measurement. These aspects are being considered by a wide group of experts from around the world who have joined together to write a comprehensive set of standards for dosimetry for radiation processing. Originally formed in 1984 to develop standards for food processing dosimetry, the group has now expanded into a full subcommittee of the American Society for Testing and Materials (ASTM), with 97 members from 19 countries. The scope of the standards now includes dosimetry for all forms of radiation processing. The group has now completed and published four standards, and is working on an additional seven. Three are specifically for food applications and the others are for all radiation applications, including food processing. Together, this set of standards will specify acceptable guidelines and methods for accomplishing the required irradiation treatment, and will be available for adoption by national regulatory agencies in their procedures and protocols. 1 tab.

21884 **(INIS-mf—11924) Limits of radiometric constituent analysis in hydraulic bulk transport of coarse, crude coal or slate with varying grain size distribution.** Sold, W. (Bergbau-Forschung G.m.b.H. Forschungsinstitut des Steinkohlenbergbauvereins, Essen (Germany, F.R.)). 14 Aug 1984. 15p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757370/JAW.

The Bergbau-Forschung GmbH is running an experimental system for radiometric constituent analysis in the bulk transport of crude coal and slate in order to test its suitability to supplement the usual gamma ray attenuation method for density analysis. The test system uses two gamma beams of different energy for continuous determination of the shale or coal amounts in the three-component mixture of shale, coal and water. The analysing unit is fixed to the upper part of the conveying pipe, the solids transport velocity measuring apparatus is installed below. A lead collimator at the upper tube end contains the two gamma sources Cs-137 and Am-241, with activities of 0.37 GBq and 376 GBq, respectively. At the opposite side, there is the scintillation counter with the NaJ detector.

21885 **(KAERI/RR—560/86) Survey on industrial applications of radioactive tracers.** Kim, Jae Rok; Yoo, Young Soo; Lee, Jong Doo; Awh, Ok Doo; Kim, Jun Hyung. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Dec 1986. 93p. (In Korean). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705860/JAW.

Current status and future feasibilities of industrial tracer applications in the Republic of Korea have been surveyed. Microleak detection using Krypton-85 in eight electronics industrial companies, and efficiency tests of steam generators in four nuclear power plants using Sodium-24 are the principal applications in Korea. Future applications are expected for mercury inventory in one soda industrial company, and alkali movement studies in two cement industrial companies. Korean industries expressed deep interest in leak detection in underground pipelines, abrasion/corrosion studies, mixing rate and residence time measurements.

21886 **(NUREG—1345) Review of events at large pool-type irradiators.** Trager, E.A. Jr. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Programs). Mar 1989. 56p. NTIS, PC A04/MF A01 - GPO - OSTI. Order Number TI89009126/JAW.

Large pool-type gamma irradiators are used in applications such as the "cold" sterilization of medical and pharmaceutical supplies, and recent changes in federal regulations make it possible they will be used extensively in the preservation of foodstuffs. Because of this possible large increase in the use of irradiators, the Office of Nuclear Materials Safety and Safeguards was interested in knowing what events had occurred at irradiators. The event data would be used as background in developing new regulations on irradiators. Therefore, AEOD began a study of the operating experience at large, wet source storage gamma irradiators. The scope of the study was to assess all available operating information on large (≧ 250,000 curie), pool-type irradiators licensed by both the NRC and the Agreement States, and events at foreign facilities. The study found that about 0.12 events have been reported per irradiator-year. Most of these events were precursor events, in that there was no evidence of damage to the radioactive sources or degradation in the level of safety of the facility. Events with more significant impacts had a reported frequency of about 0.01 event per irradiator-year. However, the actual rate of occurrence of events of concern to the staff may be higher because there are few specific reporting requirements for events at irradiators. It is suggested that during development of a regulation for large pool-type irradiators consideration be given to specifying requirements for: reporting breakdowns in access control systems; periodic inspection of the source movement and suspension system; systems to detect source leakage and product contamination; allowable pool leakage; and feedback of information on operational events involving safety-important systems.

21887 **(ORNL/TM—11027) Final report on Seed Money Project 3210-0346: Feasibility study for californium cold neutron source.** Alsmiller, R.G.; Henderson, D.L.; Montgomery, B.H. (Oak Ridge National Lab., TN (USA)). Oct 1988. Contract AC05-84OR21400. 86p. NTIS, PC A05 - OSTI. Order Number DE89008977/JAW.

A study has been completed of the feasibility and cost of building a cold neutron source that is not dependent on a reactor or accelerator. The neutron source is provided by up to ten ^{252}Cf capsules, each containing 50 mg of the isotope produced in the High-Flux Isotope Reactor. The neutrons are moderated by heavy water and liquid deuterium to attain, in practice, a peak cold neutron flux of 1.4 {times} 10^{13} neutrons/(m^2 {center←dot}s). The new facility would be located in the TURF Californium Facility. The estimated cost of the Californium Cold Neutron Source Facility is $6.5 million. 6 figs., 1 tab.

0703 Isotopic Power Supplies

21888 **(DOE/ET/32043—T26-Vol.2-Bk.2) Final safety analysis report for the Galileo Mission: Volume 2, Book 2: Accident model document: Appendices.** (General Electric Co., Philadelphia, PA (USA). Valley Forge Space Center). 15 Dec 1988. Contract AC01-79ET32043. 694p. NTIS, PC A99 - OSTI. Order Number DE89007271/JAW.

This section of the Accident Model Document (AMD) presents the appendices which describe the various analyses that have been conducted for use in the Galileo Final Safety Analysis Report II, Volume II. Included in these appendices are the approaches, techniques, conditions and assumptions used in the development of the analytical models plus the detailed results of the analyses. Also included in these appendices are summaries of the accidents and their associated probabilities and environment models taken from the Shuttle Data Book (NSTS-08116), plus summaries of the several segments of the recent GPHS safety test program. The information presented in these appendices is used in Section 3.0 of the AMD to develop the Failure/Abort Sequence Trees (FASTs) and to determine the fuel releases (source terms) resulting from the potential Space Shuttle/IUS accidents throughout the missions.

08 HYDROGEN

0805 Safety

21889 **(NRC/HSC—NRCC27406) Safety guide for hydrogen.** Kalyanam, K.M.; Hay, D.R. (National Research Council of Canada, Ottawa, Ontario. Hydrogen Safety Research Committee). 1987. 116p. (MICROLOG—88-03215). National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, Canada K1A 0R6; $12.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This document outlines the general areas where the unique properties of hydrogen combine to create potential hazards, and the various techniques and methods commonly practised in industry for the dentification, analysis, assessment, and avoidance of these hazards. Regulations, codes, standards and recommended practices are also given. Inherent risks are described in the areas of leakage and spillage, combustion, detonation, reactions with other materials, embrittlement, asphyxiation, and cryogenic hazards. Risk aversion methods include separation of equipment, control of hydrogen accumulation within enclosures, exclusion of air, leakage detection, selection of proper construction materials, and spill containment of liquid hydrogen. Lists of relevant Canadian and US hydrogen codes are included. 188 refs., 4 figs., 4 tabs.

09 OTHER SYNTHETIC AND NATURAL FUELS

21890 **(CONF-8711230—) Practical quality specifications for vehicle fuels. Proceedings.** Schindlbauer, H. (ed.). (Technische Univ., Vienna (Austria). Forschungsinstitut fuer Chemie und Technologie von Erdoelprodukten (FICHTE)). 1987. 206p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE89770288/JAW.

From 4. information seminar on practical requirements on fuel quality; Vienna, Austria (18 Nov 1987).

Seven papers were presented at the fourth seminar on the subject of 'practical quality specifications for vehicle fuels'. The titles of the experts' presentations were: Fuel requirements from the view of the engine makers; the limitations of fuel composition from the viewpoint of the refiners; legal regulations governing fuel and exhaust specifications in Europe; additives - yes or no; diesel fuel composition and emissions; carburetor fuel composition and emissions; market research for carburetor fuels. A separate data entry has been made for each of the seven papers. (HWJ).

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 21893, 21918, 21923, 22378, 22685

21891 **(AFME—84.9670) Methanic bio-conversion of bark tannage residues.** Aloy, M. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). Feb 1987. 56p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88757221/JAW.

The un-tanned solid residues and the sewage sludges produced by the tanneries and the taweries are rich in organic matters (proteins and fatty matters) and products with enough humidity content to be biodegradated through methanic fermentation. This technology was assessed in a prototype large scale reactor: experimental results are presented. An economic feasibility study is also described.

21892 **(AFME—85.01.1031) Technical follow-up of methane production rural plants.** Theoleyre, M.A. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). Jun 1987. 130p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88757213/JAW.

The various types of methanic fermenters installed in France for agricultural wastes up-grading are reviewed. The characteristics of the liquid manures are described and the performances and characteristics of each visited plants are presented: technical assessment (input /output rate, pollution abatement, system reliability), energetic evaluation (energy ouput/energy input) and economic analysis (payback time).

21893 **(DOE/PC/80016—T7) Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 9, 1 October--23 December 1987.** Tong, G.T.; McCarty, J.G. (SRI International, Menlo Park, CA (USA)). 1987. Contract AC22-85PC80016. 13p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009568/JAW.

The medium-level sulfur-treated (50% monolayer sulfur coverage) iron and cobalt catalysts were tested for FTS activity, with the clean fused iron catalyst tested as a comparative standard for the fixed-bed reactor operated at high pressure (2 MPA). Of the four improved catalysts chosen for evaluation at high pressure FTS synthesis, the medium-level sulfur-treated fused iron catalyst seems most promising, with a 50% reduction in methane yield, a narrower product distribution, and a threefold increase in olefin selectivity. The sulfur-treated catalyst exhibited behavior at 2 MPa similar to the 0.1 MPa synthesis run; however, the olefin selectivity decreased with increasing temperature or pressure. 5 figs., 2 tabs.

21894 **(DOE/PC/80016—T8) Improved Fischer-Tropsch synthesis catalysts for indirect coal liquefaction: Quarterly technical progress report No. 10 for the period 1 January to 31 May 1988.** Tong, G.T.; McCarty, J.G. (SRI International, Menlo Park, CA (USA)). 1988. Contract AC22-85PC80016. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009582/JAW.

The synthesis of aromatics was performed on several combinations of Fischer-Tropsch (FT) and sodium Y-zeolite catalysts in a fixed-bed reactor with an H_2/CO ratio of 0.5, 2.0-MPa pressure, and a temperature range of 548 to 700 K. Medium-level sulfur-treated fused iron and sulfur-treated alumina-supported ruthenium were used as the Fischer-Tropsch synthesis catalysts and compared with results using clean fused iron and clean ruthenium catalysts. The mixed catalysts initially provided high yields of light oxygenates and aromatics with low yields of olefins but deactivated rapidly, probably due to carbon deposition, especially at higher temperatures. The catalyst reactivity could be prolonged by using a higher zeolite/FT catalyst ratio and by using zeolites with higher sodium weight loading. These results compare favorably with prior similar studies performed under less severe coking conditions. 11 refs., 3 figs., 2 tabs.

21895 **(DOE/PC/80513—T5) Models for surface intermediates in CO hydrogenation: Final report.** Messerle, L. (Iowa Univ., Iowa City (USA). Dept. of Chemistry). 1988. Contract FG22-85PC80513. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004348/JAW.

We have discovered the first example of intermolecular C{minus}H bond activation by a metal-metal multiply-bonded complex. Reductive dimerization of the Ta(V) organometallic ({eta}-C_5Me_4R)$TaΞ_4$(R = Me, Et; Ξ = Cl, Br) yields a novel class of highly-reactive dinuclear complexes $(C_5Me_4R)_2Ta_2(\mu\text{-}Ξ)_4$, which possess quadrupole bridged Ta(III)-Ta(III) double bonds of $\sigma^2\delta^2$ electronic configuration. The nonbonded ditantalum(IV) intermediate in the reduction, $(C_5Me_4R)Ta_2(\mu\text{-}Ξ)_2Ξ_4$, has been characterized. The Ta = Ta complexes insert into the vinylic C{minus}H bond of 1-alkenes under mild conditions to yield the ditantalum vinyl hydride $(C_5Me_4R)_2Ta_2Ξ_4(\mu\text{-}H)(\mu,$ {eta}^{2}-CHCHR'). The Ta = Ta complex inserts into other σ-bonds, adding H_2 to yield $(C_5Me_4R)_2Ta_2(\mu\text{-}H)_2Ξ_4$. It inserts into B{minus}H bonds, resulting in dehydrodimerization of BH_4/sup {minus}/ groups to $(C_5Me_4R)_2Ta_2(\mu\text{-}Ξ)_2(\mu\text{-}B_2H_6)$ with a μ-diborane group. These reactions with olefins and BH_4/sup {minus}/ are unprecedented in dinuclear M{minus}M multiple bond and early metal chemistry. We have also found an example of direct enolate generation from CO insertion into a metal alkyl, and have made a major breakthrough for developing lower-valent organovanadium and divanadium chemistry. 8 figs.

21896 (NP—9770326, pp 102-113) **Adapting biogas production to conditions in practice.** [1984]. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770326/JAW.

In Agriculture in Hessen. Hessian Land programme for promoting the development of renewable energy sources and their use in agriculture.

With 1,4 kg/m/sup 3/ the space required is quite moderate which correspondingly means a digestion period of 51 days and a decomposition of organic dry matters of 40%. Gas yield is 470 l of biogas per kg of organic dry matter on average and remains within the usual values. At full utilization of the manure produced by 80 units of livestock for biogas production the annual gross production of energy is 250 MWh. Without additional possibilities of gas utilization this means a gas efficiency of 30%. In the long run it is therefore indispensable to find additional ways of gas utilization.

21897 (NP—9770326, pp 114-121) **Pilot project: Biogas plant.** Kring, R. [1984]. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770326/JAW.

In Agriculture in Hessen. Hessian Land programme for promoting the development of renewable energy sources and their use in agriculture.

At a possible yearly plant output of 135 MWh - considering the 30% lower gas output during the summer months due to cattle pasturing and an annual process energy demand of 25% - the gas utilization comes up to 44%. With a daily supply of organic dry matter of only 1,5 kg/m/sup 3/ digester volume the plant has not yet been used to its full capacity and has produced only 94 MWh usable energy last year. This means a gas utilization degree of about 70%. A recently installed gas motor-generator unit will lead to a significant increase of the gas utilization. In how far this will increase the overall efficiency of the plant is something that only future evaluations and measurements will show.

21898 **(NYSERDA—89-1) Methane from partially digested sewage sludge using a steam injection rapid thermal reactor: Final report.** (New York State Energy Research and Development Authority, New York (USA); Brooklyn Union Gas Co., NY (USA); Dynatech Scientific, Inc., Cambridge, MA (USA)). Feb 1989. 409p. OSTI - New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223. Order Number TI89008780/JAW.

The partially digested water (PDS) from New York City's wastewater treatment plants alone, if completely digested, represents a potential energy resource equivalent to about 1,600 standard cubic feet of methane gas per minute. Recognizing this potential,

several authorities sponsored a research program to test processes which recover additional energy from PDS and reduce the quantity of sludge for disposal. In this project, PDS was subjected to elevated temperatures and pressures followed by anaerobic digestion. A range of exposure times was tested using lab-scale batch and continuous flow thermal reactors. In some cases, alkali or acid compounds and air were simultaneously added to the PDS prior to heating. Processing in this manner was found, in other research with cellulosic material, to cause the hydrolytic or hydrolytic-oxidative breakdown of cellulose to simple sugars. Similar effects were expected for PDS. By systematically varying single parameters, i.e., temperature, residence time, pressure, pH, and oxygen, conditions were sought to enhance conversion of PDS volatile solids to low-molecular-weight dissolved solids and/or increase the anaerobic biodegradability of the PDS. A summary of test conditions is as follows: temperatures in the thermal reactor of 140{degree}C to 250{degree}C; pressures in the reactor of 250 psia to 300 psia and residence times of 1 to 30 seconds up to one hour; the addition of sodium hydroxide, or sulfuric, hydrochloric, and phosphoric acids to change the pH of the PDS from 6.8 to 7.9 to a pH of 1.5 to 12.2; and the addition of air prior to pressurizing the reactor vessel.

21899 **(UCRL—100489) The high temperature oxidation of isobutene.** Held, T.J.; Dryer, F.L.; Brezinsky, K.; Pitz, W.J.; Westbrook, C.K. (Lawrence Livermore National Lab., CA (USA)). 1 Mar 1989. Contract W-7405-ENG-48. 6p. (CONF-881215—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008661/JAW.

From Chemical and physical processes in combustion; Clearwater Beach, FL, USA (5 Dec 1988).

Isobutene has been identified as an important intermediate in the high temperature oxidation of several hydrocarbons, and as the primary intermediate formed during low temperature, pre-knock reactions in an engine study of isobutane. The possible role of isobutene in inhibiting autoignition has been discussed previously, and its effect on the high temperature oxidation of n-heptane was demonstrated. Despite the practical interest in understanding the oxidation of isobutene, few experimental results are available, and these results are primarily at relatively low temperatures (< 480 C). The present study examines the oxidation of isobutene at approximately 1140K over a range of stoichiometries. A detailed chemical kinetic reaction mechanism has been developed and refined through comparison with the experimental data. The model clarifies the nature of the inhibitory effect of isobutene on the oxidation rate. 17 refs., 3 figs.

21900 **Anaerobic digestion of municipal solid waste and sludge.** Chynoweth, D.P.; Legrand, R. (Univ. of Florida, Gainesville, FL (US); Reynolds, Smith and Hills, Jacksonville, FL (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889441.

Results of a systems analysis suggest that conversion of the biodegradable fraction of municipal solid wastes and domestic sewage sludge to methane via anaerobic digestion coupled with combustion or gasification of refractory components is an economic and environmentally attractive option for treatment of these wastes. A spreadsheet systems model for evaluation of various treatment options for these wastes will be presented. The same model is employed to describe sensitivities of various unit operations with anaerobic digestion as a central conversion process. A summary of various anaerobic digestion options for Municipal Solid Waste (MSW) treatment is presented, including RefCoM, SOLCON, DRANCO, VALGORA, and leach-bed attached film.

21901 **Pyrolysis experiments with municipal solid waste components.** Helt, J.E.; Mallya, N. (Chemical Technology Div., Argonne National Lab., 9700 South Cass Avenue, Argonne, IL (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889513.

A majority of the combustible portion of municipal solid waste (MSW) is cellulosic in nature, comprising paper, newsprint, packaging materials, wood wastes, and yard clippings. If this material is pyrolyzed, the end products are: a highly carbonaceous solid char, a highly oxygenated liquid tar, and a mixture of gases with low to medium Btu content. All of the pyrolysis products offer the potential of being useful fuels or the intermediates for producing useful fuels. Current research at Argonne National Laboratory (ANL) is focused on obtaining a better understanding of the basic mechanisms, kinetics, and chemistry involved in the pyrolytic conversion of MSW and its components. Newsprint, kraft paper, polyethylene, and densified refuse-derived fuel (RDF) have been used individually and in mixtures as feedstock in a batch laboratory reactor. The pyrolysis has been at atmospheric pressure and temperatures of 350°-800°C. The products from the pyrolysis reaction have also been analyzed for both fuel properties (e.g., viscosity, calorific value, acid group concentrations) and chemical composition. The liquid products have been studies extensively using Fourier transform infrared spectrometry. Discussion is provided on the overall chemical mechanisms associated with the pyrolytic decomposition.

21902 **Catalytic conversion of microalgae and vegetable oils to premium gasoline, with shape-selective zeolites.** Milne, T.A.; Evans, R.J. (Chemical Conversion Research Branch, Solar Fuels Research Div., Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889355.

A seminal paper by Mobil researchers in 1979 demonstrated that a remarkable range of materials were convertible to a similar, high-octane, aromatic, gasoline product slate when passed over HZSM-5, a medium-pore, shape-selective, acid catalyst. These materials ranged from low molecular weight oxygenates, such a methanol, to high molecular weight latexes and vegetable oils. In this paper the authors briefly review the thermochemical conversion options for algal and vegetable lipids, present the potential advantages of the zeolite approach and consider the possibility of converting either the whole algae or vegetable oil seed, or crudely extracted lipids, too a product virtually independent of fatty acid composition of the lipid. Experimental data on pyrolysis, and on product slates and yields over HZSM-5, are shown for rapeseed, rapeseed oil, tripalmitin and algal lipids. The pyrolyzer-catalytic reactor, and the ambient-pressure, molecular-beam, mass spectrometric analytical sampling system, are shown and briefly described.

21903 **Thermal gasification of biomass.** Schiefelbein, G.F. (Pacific Northwest Lab., P.O. Box 999, Richland, WA (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889353.

Biomass represents an important energy resource at present and offers great potential for increased energy impact in the future. The Office of Technology Assessment and the Energy Research Advisory Board have estimated that, with proper resource management and the development of efficient conversion processes, biomass is capable of supplying ten to twenty percent of the nation's energy needs by the year 2000. In this paper biomass gasification research sponsored by the U.S. Department of Energy's Biomass Thermochemical Conversion Program is discussed. The main thrust of this research is directed toward the production of medium-energy content gases containing 12-21 MJ/NM/sup 3/. this research effort encompasses both directly heated and indirectly heated gasification reactor concepts. Research on fixed-bed and entrained gasification reactors operating at ambient and elevated pressures is discussed. Information on a unique gasification proves for

high moisture feedstocks and research on catalytic gas cleanup methods is also presented.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 21903, 21918

21904 **(DOE/PC/70021—1) Direct synthesis of 2-methyl-1-propanol/methanol fuels and feedstocks: Technical progress report, September 1984--February 1985.** Klier, K.; Herman, R.G.; Simmons, G.W. (Lehigh Univ., Bethlehem, PA (USA)). Mar 1985. Contract AC22-84PC70021. 48p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008257/JAW.

The present program of research stems from our recent discovery that cesium surface-doped methanol synthesis catalysts, based on copper-zinc oxide, are very effective in producing C_2-C_7 alcohols, in addition to methanol, with the dominant product being 2-methyl-1-propanol. The underlying mechanistic principle is that of base-catalyzed condensation of alcohol precursors with the C_1 aldehydic intermediate that is formed by CO hydrogenation over the Cu/ZnO of the catalyst. This base catalysis results in three types of reactions: (1) linear growth, (2) beta branching, and (3) coupling via oxygen to form small amounts of esters. These types of reactions are characterized as i/sub C-O/ (type i), β/sub C/ (type ii), and α/sub O/ (type iii). We have demonstrated that conditions can be found over the Cs/Cu/ZnO catalyst under which β/sub C/>i/sub CO/>>α/sub O/. The extent research has progressed in the direct synthesis of 2-methyl-1-propanol/methanol mixtures is detailed in Attachment 1. In a search for the best composition and initial state and dispersion of the aluminum-containing component in alumina-based alcohol synthesis catalysts, where the alumina will aid the long term stability of the catalyst system, series of $Cu/ZnO/Al_2O_3$ and $Cs/Cu/ZnO/Al_2O_3$ are being prepared and characterized. In order to determine the role of preparation conditions on the formation of active, stable, and selective catalysts, the catalyst precursors formed during the coprecipitation process are being identified. Descriptions of the precursors and the methods used in their identification are given in Attachment 2. 1 tab.

21905 **Ethanol from lignocellulose - An overview.** Wright, J.D. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889357.

Ethanol, a liquid fuel compatible with today's transportation system, can be produced by biological processes from lignocellulosic feedstocks. Biomass is an attractive feedstock for ethanol production because it is available in large quantities at low cost. Biological processes are very efficient, but each fraction of the lignocellulosic feedstock must be processed separately. Cellulose (a crystalline polymer of glucose), the structural core, comprises 40% of the feedstock. It is difficult to hydrolyze (break down) into glucose, but once formed, the glucose is readily fermented to ethanol. Cellulose can be hydrolyzed with either acid or enzymatic catalysts. Using acids, the chief problem is that conditions severe enough to promote hydrolysis also degrade the glucose, resulting in low (50%-80%) yields. Enzymatic processes are potentially much more efficient because enzymes catalyze only the hydrolysis reaction. However, these processes are much newer and less developed. Research is required to develop methods to make lignocellulose more edigestible, to produce more active enzymes at lower cost, and to develop methods of hydrolysis where enzyme action is not inhibited by reaction end products.

21906 **Monte Carlo simulation as a research management tool.** Douglas, L.J. (Solar Fuels Research Div., Solar Energy Research Institute, Golden, CO (US)). pp v of Proceedings of the TAPPI 1986 research and development conference. Atlanta, GA; Tappi Press (1986). (CONF-8609290—).

From Tappi research and development conference; Raleigh, NC, USA (28 Sep 1986).

Monte Carlo simulation provides a research manager with a performance monitoring tool to supplement the standard schedule- and resource-based tools such as the Program Evaluation and Review Technique (PERT), and Critical Path Method (CPM). The value of the Monte Carlo simulation in a research environment is that it 1) provides a method for ranking competing processes, 2) couples technical improvements to the process economics, and 3) provides a mechanism to determine the value of research dollars. In this paper the Monte Carlo simulation approach is developed and applied to the evaluation of three competing processes for converting lignocellulosic biomass to ethanol. The technique is shown to be useful for ranking the processes and illustrating the importance of the time-frame of the analysis on the decision process. The results show that acid hydrolysis processes have higher potential for near-term application (2-5 years), while the enzymatic hydrolysis approach has an equal chance to be competitive in the long term (beyond 10 years).

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 21614, 21646, 22378

21907 (NP—9770326, pp 57-70) **Combustion of straw as a solid fuel.** [1984]. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770326/JAW.

In Agriculture in Hessen. Hessian Land programme for promoting the development of renewable energy sources and their use in agriculture.

The straw combustion system with the Loibl boiler STK 70 does not achieve the heat output advertised by the manufacturers. It is hardly possible to control the combustion process and the flue gas values rise enormously after a new bale is put in. After feeding two bales of straw to the system the mass concentration in the flue gas was extremely high and the temperature rose to 586/sup 0/C. Even with one bale the soot coefficient was 9 while it was only 5 when the system was fueled with wood. With such emission values it is advisable to run the system on wood only. In terms of overall cost straw is even more expensive than oil which is mainly due to the higher wage costs incurred.

21908 (NP—9770326, pp 71-76) **Pilot project: Straw-fueled heating system.** Reichardt, A. [1984]. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770326/JAW.

In Agriculture in Hessen. Hessian Land programme for promoting the development of renewable energy sources and their use in agriculture.

A straw-combustion system has been supplying the heat for the residential building of this farm since January 1982. The high investment costs of the project and the measured output do not, however, give a complete picture of the task and performance of the system because the project as such has not yet been fully completed. Once the animal sheds can also be heated and once the system is connected to the thermal storage unit, the straw consumption and plant efficiency will improve. From the technical point of view, however, the plant functions well.

21909 (NP—9770326, pp 77-84) **Pilot project: Straw combustion plant.** Bauer, G. [1984]. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770326/JAW.

In Agriculture in Hessen. Hessian Land programme for promoting the development of renewable energy sources and their use in agriculture.

Despite some technical improvement the system initially did not achieve the full output indicated by the manufacturer. A comparison of costs shows that even with the subsides the costs are still higher than the costs of oil heating. The performance depends on the amount of straw combusted per hour which the manufacturer says is 45 min/bale. First measurement however proved it to be 1,6 h/bale which led to a boiler performance of 143 kW only. Even dry straw performed little better bringing about a short-term boiler performance increase up to 250 kW. Thorough servicing and alterations in the combustion chamber carried out at the beginning of

the heating period pushed the performance up to 758 kW. If this could be kept up over the whole heating period it would lead to more favourable values also for the planning figures mentioned above. Heating costs would drop down to 0.08 DM/kWh and be thereby the same as for oil heating.

21910 (NP—9770326, pp 150-159) **Pilot project: Wood chip combustion plant.** Malsburg, G. von. [1984]. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770326/JAW.

In Agriculture in Hessen. Hessian Land programme for promoting the development of renewable energy sources and their use in agriculture.

Wood chip combustion systems as an alternative heating system can be operated at a justifiable expense of moncy and work. With the present cost structure such a system becomes interesting at an annual heating oil consumption of 10.000 l or more. The economic efficiency depends on the one hand on the level of the fixed costs and on the price of m/sup 3/ of wood chips on the other. Satisfactory automatic operation of a wood-chip combustion system is possible. The fuel, however, must be more or less homogeneous. The system uses feeder screws and due to the little space it needs it can be fitted to almost any existing heating system. If the heat demand and the chip feed are matched well and if the exchanger surfaces are cleaned regularly the waste gas temperatures will be low. Overheating does not occur and pollution is expected to be lower than in piece-wood fueled systems because the combustion process actually alternates between full operation mode and standstill. In standstill mode only a small fire is being maintained so that the production of nitric oxides, gases and emissions (tar, soot, dust etc.) is expected to drop sharply. Measurements of all these substances will be carried out during the heating period 1983/84.

21911 **In situ wood heat monitoring.** Yoder, R.A.; Modera, M.P.; Spolek, G.A. (Lawrence Berkeley Lab., CA (US)). pp v of Proceedings of the American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. 1988 winter meeting. Volume 94, Part 1. Atlanta, GA; American Society of Heating Refrigeration and Air Cond. (1988). (CONF-880128—).

From ASHRAE winter meeting; Dallas, TX, USA (30 Jan 1988).

Infrared radiometers were used to measure the heat output of 100 wood stoves during two heating seasons in homes weatherized by the Hood River Conservation Project. Radiometer readings were correlated to stove heat output using shape factor analysis and the results of calorimeter room tests. The monitoring methodology is described, and the measured heat output is compared with energy estimates based upon the reported wood consumption in these houses. The field efficiencies computed for 35 stoves for both heating seasons were surprisingly lower than the efficiencies expected from laboratory measurement, averaging only 32% in the first year and 23% in the second year. Possible causes for this discrepancy are discussed.

13 HYDRO ENERGY

REFER ALSO TO CITATION(S) 22322

1303 Plant Design And Operation

21912 (NP—9770326, pp 143-149) **Pilot project: Flowing water for heat generation.** Specht, A. [1984]. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770326/JAW.

In Agriculture in Hessen. Hessian Land programme for promoting the development of renewable energy sources and their use in agriculture.

Favourable conditions such as the existence of an intact working mill wheel made the installation of a kinetothermal system look viable. The plant is constructed in such a way as to have a long service life and incur little repair costs. The efficiency cannot yet be judged as the heating system for the residential building has not yet been finished. The heating system is to be further expanded for the next heating period. As the kinetothermal plant alone can supply only 20 kW which is not sufficient, bivalent operation with an oil boiler (15 kW) will be adopted.

1306 Environmental Aspects

21913 **(FEARO—7707) Wreck Cove hydro electric project.** (Federal Environmental Assessment Review Office, Ottawa, Ontario (Canada)). 1977. 3p. (In English and French). (MICROLOG—88-05022). Federal Environmental Assessment Review Office, Fontaine Bldg., 13th floor, Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Wreck Cove hydroelectric project on Cape Breton Island in Nova Scotia has undergone an environmental assessment to evaluate the possible impacts of a plant designed to produce 200 MW peak power. The project involves diverting a portion of headwater flows from 7 rivers, requiring four major impoundments, 19 dykes and dams, and connecting canals and tunnels. One of the impoundments, on the Cheticamp River, received special concern because of its impacts on fishing and because it would flood part of a national park. Impacts of construction and operation of the project facilities on adjacent recreational areas were also addressed. This report summarizes the views of a panel assessing the project, and presents the conclusion that the Cheticamp portion of the project may be constructed and operated provided that the recommendations in the report are implemented.

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 22354

21914 **(ANL/PPRNT—89-98) Solar radiation at the Earth's surface: What are we doing to it and with it?.** Cook, D.R. (Argonne National Lab., IL (USA)). 1989. Contract W-31109-ENG-38. 20p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008446/JAW.

This document is a brief overview of current and future applications of solar energy. Topics include solar radiation and climate, surface absorption and reflection, solar collectors, energy storage devices, and solar radiation protection. 17 refs., 2 figs., 3 tabs. (TEM)

21915 **An approach to quality assurance in a research environment.** Wells, C.V.; Nuss, G.R. (Solar Energy Research Institute, Golden, CO (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 417-425(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

As a Department of Energy (DOE) laboratory, the Solar Energy Research Institute (SERI) must observe the DOE order mandating a quality assurance (QA) program. The model presented for a QA program was ANSI/ASME standard NQA-1. Although NQA-1 is a generic standard for institutional and project QA, it proved difficult to adapt to a non-nuclear, non-production environment directed at bench/laboratory scale basic and applied research. The elements of research quality are not the same as the elements of traditional QA common to hardware, construction of manufacturing activities. This paper describes SERI's approach in developing an institutional QA program. The SERI QA effort builds upon the scientific techniques practiced by its research staff and fits these practices into a QA context.

1401 Resources And Availability

21916 (NEDOJ-OS—8742-Pt.1) Survey of development feasibility of technology concerning solar energy utilization in the south Pacific countries. Tomidate, Takao; Kimura, Toru; Suzuki, Toshiharu; Nakamura, Shigeaki; Sawada, Yoshihiro. (New Energy and Industrial Technology Development Organization, Tokyo (Japan)). May 1988. 285p. (In Japanese). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88756477/JAW.

This is a report on the results of the continued detailed survey conducted on solar energy utilization, the most promising means for development and utilization based upon the results of the survey of new energy utilization in 1986. The report mentions the demand and supply of energy in Solomon, Tonga and Kiribati which were visited for the survey, the utilization of solar power generation, etc. in the South Pacific countries and the current situation of international cooperation. It suggests also that household solar power generation, whose commercialization is now under way in lieu of diesel power generation, the current major power supply, is advantageous even in terms of cost and various industries including fisheries are expected to be developed by the introduction of large modules. Furthermore, it proposes, as the feasibility of joint researches, the contribution to a joint development of the above utilization on the level of actual service under the harsh environment of high temperature, high humidity and high salinity, and the application study of a centralized solar beam power generation system to the selected small atoll countries which lack the water resources and have no or very poor biomass resources. (5 figs, 40 tabs, 54 refs)

1403 Economics

REFER ALSO TO CITATION(S) 21916

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 21614, 21646, 21892, 21896, 21897, 21900, 21901, 21902, 21903, 21905, 21906, 21907, 21908, 21909, 21910, 21952, 22378, 22419, 23198

21917 (AFME—82.066.10) Biological conversion of solar energy. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris; Centre National de la Recherche Scientifique, 75 - Paris (France). Programme Interdisciplinaire de Recherche sur les Sciences pour l'Energie et les Matiernes Premieres (PRISEM)). 1987. 821p. (In French). (AFME—85.1002.10). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757224/JAW.

The various research programs (1982-1987) concerning the biological conversion of solar energy in France are reviewed: scientifical basis for the forest production, photosynthesis, knowledge of algae, physiology and genetics of algae and bacteria, direct bioconversion of solar energy, stability of the immobilized or un-immobilized photosynthetic organites, acetonobutylic fermentation, enzymatic engineering and fermentations, biotechnology process engineering.

21918 (AFME-Z—0086) Biomass: results and prospects. Joly, J.; Abrassart, E.; Laufer, P. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). Apr 1987. 193p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88757220/JAW.

The aquatic, forest and agricultural biomass quantities and productivities in France are reviewed. The state of the art of the various biofuel conversion technologies are then described and the application potentials are analyzed: direct combustion of biomass or biofuel fabrication. The economic feasibilities of the different schemes are evaluated with regard to the size of the equipment (residential space heating, central heat supply system, engines, power station, etc.).

21919 (CFS/SJN—1987) [Newfoundland Forestry Centre] Program review, 1986-87. (Canadian Forestry Service, St. John's, Newfoundland). 1987. 57p. (MICROLOG—88-04088). Petawawa National Forestry Institute, Library, Forestry Canada, Chalk River, ON, Canada K0J 1J0; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Newfoundland Forestry Centre conducts programs of research and development in support of the forest resource of the Newfoundland and Labrador region. This report summarizes the year's activities in the three major program areas of forest protection research, forest resources and envionmental research, and forest development. An outline of the Centre's administration, support services, finances, and organization is also provided. Individual projects are described in the areas of environmental assessment of forestry practices, forest and plant ecology, reforestation, tree and stand growth, energy from forest biomass, pest biology, biological control, forest insects and diseases, and economic studies. A list of publications is included. 125 refs., 14 figs., 1 tab.

21920 (DOE/CE/15270—T9) Explorations of mechanisms regulating ectomycorrhizal colonization of boron-fertilized pine: Quarterly report, January 1, 1989--March 31, 1989. Garrett, H.E.; Begonia, G.; Sword, M.A. (Missouri Univ., Columbia (USA). School of Forestry, Fisheries and Wildlife). 1989. Contract FG01-86CE15270. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009540/JAW.

This report describes four experiments that test the chemical basis of mycorrhizal colonization in the root system of pine trees. This quarter, modifications to the experimental design are described, plant growth data are included, and phenolic compounds produced by pine trees in responce to colonization are evaluated. 7 refs., 1 tab. (TEM)

21921 (DOE/ER/13704—2) Processing and targeting of the thiol protease, aleurain. Rogers, J.C. (Washington Univ., Seattle (USA)). [1989]. Contract FG02-87ER13704. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009295/JAW.

We have identified a cDNA clone from barley aleurone mRNA that encodes a protein with unusual homologies: the C-terminal portion, about 270 amino acids, is 65% identical to the mammalian thiol protease, cathepsin H. This degree of sequence conservation indicates that the enzyme must have some specific function in both plants and mammals that cannot tolerate further divergence. The N-terminal 1/3 of the protein, about 140 amino acids, has no detectable homologies to other known protein sequences; its function is unknown. In aleurone tissue, the mRNA level is increased by gibberellic acid and decreased by abscisic acid, but is expressed apparently constitutively at high levels in leaf and root tissues. The amino acid sequence and cathepsin H homology suggest that the protein will be both secreted into the endoplasmic reticulum and glycosylated. Using our cDNA clone in a bacterial expression system, we have made a fusion protein containing the protease domain of aleurain, and have used it to raise specific antisera in rabbits. These antibodies identify a 32 kd protein in extracts of aleurone layers that is induced with GA treatment but not secreted; a similarly sized protein is specifically identified in extracts of leaf tissue. Experiments are underway to characterize the pattern of expression in different tissues, to identify the subcellular locations of the protein, to characterize processing of the precursor to the 32 kd mature form, and to purify the enzyme from barley. 2 figs.

21922 (DOE/ER/13903—T1) [Biosynthesis and assembly of cell wall polysaccarides in cereal grasses]: Progress report. Carpita, N.C. (Purdue Univ., Lafayette, IN (USA). Dept. of Botany and Plant Pathology). [1989]. Contract FG02-88ER13903. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008417/JAW.

We are investigating the biosynthesis of mixed-linkage β-D-glucan and glucuronoarabinoxylans which make up the hemicellulosic matrix of the primary cell walls of maize and other cereal grasses. The Golgi apparatus was enriched from plasma membrane

and other organelles by flotation density gradient centrifugation. Glucan synthase I and II, which are established markers for Golgi and plasma membrane, respectively, displayed considerable overlap in conventional separations with sucrose density gradients. Flotation gradients improved separation of the membranes substantially, but the different synthases themselves also incorporated radioactivity from either 10 μM or 1 mM UDP-[^{14}C]-glucose into polymer. Relative incorporation of radioactivity into polymers from UDP-[^{14}C]-xylose by the various membrane fractions was nearly identical to relative IDPase activities, indicating that combined xylosyl transferase-xylan synthase represents a new, unequivocal marker for the Golgi apparatus. We developed techniques of gas-liquid chromatography and radiogas proportional counting to achieve capillary quality separation of partially methylated alditol acetates with simultaneous determination of radioactivity in the derivatives. We determined that both terminal and 4-linked xylosyl units from UDP-[^{14}C]-xylose and 3- and 4-linked glucosyl units from UDP-[^{14}C]-glucose were formed with Golgi membranes, whereas the plasma membranes made mostly 3-linked glucosyl units. We now are using digestion of polymeric products by specific endo-glycanohydrolases to diagnostic oligosaccharides that reveal specific kinds of polysaccharides synthesized by the Golgi membranes.

21923 **(PIRSEM—1042) Cellulose bioconversion.** Belaich, J.P.; Bruschi, J.P.; Cattaneo, J.; Hatchikian, C. (Centre National de la Recherche Scientifique, 75 - Paris (France). Programme Interdisciplinaire de Recherche sur les Sciences pour l'Energie et les Matiernes Premieres (PRISEM)). 1983. 21p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757222/JAW.

The growth of three cellulolytic organisms have been studied: cellulomonas sp., Clostridium cellulolyticum and Cellulomonas X. The metabolism of these bacteria, the influence of the growth kinetics on the stoichiometry of the fermentations and the electron interspecific transfers applied to methanic bioconversion (sulphate-reducer bacteria, cellulolytic bacteria and methanogenous bacteria) are presented. The electron transfer mechanism, the oxidation-reduction properties of proteins, the structure-function relations and the thermal stability of enzymes are precised.

21924 **(PNFI—1988) Guidlines for forest biomass inventory.** Aldred, A.H.; Alemdag, I.S. (Institut Forestier National de Petawawa, Chalk River, Ontario (Canada)). 1988. 131p. (MICROLOG—88-03564). Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, Canada K1A 1G5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This manual presents guidelines for including forest biomass assessment in forest inventory. The purpose of the guidelines is to draw together a uniform set of definitions, standards, and procedures that recognize current forest inventory practice and which are practical and simple to use. A general description is provided of biomass measurement, including how it relates to the larger inventory problem. The description includes, where necessary, background, definitions of terms, equations, references, examples, and theoretical considerations. The manual addresses sampling designs, which determine where to select the samples, how much data to collect, and how to use readily available data to increase efficiency of sampling. Field and laboratory procedures are then presented for measuring and recording basic data, developing equations for estimating biomass quantities from easily-measured tree variables, and applying biomass estimation models to forest inventory. 63 refs., 13 figs., 28 tabs.

21925 **(SERI/STR—211-3446) Research on amorphous-silicon-based, thin-film photovoltaic devices, Task B: Annual subcontract report, January 1, 1988--August 31, 1988.** Bottenberg, W.; Mitchell, K. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1989. Contract AC02-83CH10093. 70p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000885/JAW.

This report contains results of research undertaken to develop 13% efficient four-terminal hybrid tandem photovoltaic submodules with an aperture area of 850 cm^2. The modules would have a copper-indium-diselenide-based (CIS) bottom circuit and a semi-transparent thin-film silicon-hydrogen (TFS) top circuit. The work resulted in a measured efficiency of 14.5% for the 4-cm^2 CIS/TFS tandem device and 12.3% for the tandem 30 {times} 30 cm submodule, which exceeded project goals. Stability remained an important issue for TFS in terms of performance, however. An initial loss of 15%-20% was typical. The data suggest no fundamental stability problem with CIS. 26 refs., 46 figs., 20 tabs.

21926 **Amorphous silicon solar cells with ethylene-based p$^+$ layers.** Wiedeman, S.; Smoot, M.; Fieselmann, B. (Solarex Corporation, Thin Films Division, 826 Newtown--Yardley Road, Newton, Pennsylvania 18940). *Applied Physics Letters;* **54**: No. 16, 1537-1539(17 Apr 1989).

The use of ethylene (C_2H_4) rather than methane (CH_4) as the source of carbon in the hydrogenated amorphous silicon carbide (a-SiC:H) p$^+$ layer of hydrogenated amorphous silicon (a-Si:H) based solar cells deposited in a glow discharge has been explored. Device results are presented to demonstrate the utility of ethylene-based a-SiC:H for use in the p$^+$ layer. Device results and material measurements reveal that the use of ethylene under the proper conditions can yield p$^+$ a-SiC:H which has optical and transport properties which are at least as suitable as methane-based material.

21927 **Doped surfaces in one sun, point-contact solar cells.** King, R.R.; Sinton, R.A.; Swanson, R.M. (McCullough 204, Stanford University, Stanford, California 94305). *Applied Physics Letters;* **54**: No. 15, 1460-1462(10 Apr 1989).

This letter reports two new types of large-area (>8.5 cm^2), backside, point-contact solar cells with doped surfaces, designed for use in unconcentrated sunlight. One type was fabricated on an intrinsic substrate with an optimized phosphorus diffusion on the sunward surface. The apertured-area efficiency was independently measured to be 22.3% at 1 sun (0.100 W/cm^2), 25 °C, the highest reported for a silicon solar cell. The other type is constructed on a doped substrate, and has an apertured-area efficiency of 20.9%, the highest reported for a point-contact solar cell with a base in low-level injection. Both cells have record open-circuit voltages above 700 mV.

21928 **Inhibition of electron transport in photosystem II by NH_2OH: further evidence for two binding sites.** Sivaraja, M.; Dismukes, G.C. (Princeton Univ., NJ (USA)). *Biochemistry;* **27**: No. 17, 6297-6306(23 Aug 1988). Contract FG02-84CH10199.

The reaction of hydroxylamine, a substrate analogue of the water-oxidizing complex (WOC), with spinach photosystem II (PSII) membranes has been further studied by using EPR spectroscopy to monitor the stepwise oxidation of donors and reduction of electron acceptors during successive low-temperature illuminations. In addition to its well-known binding on the donor side of PSII, hydroxylamine binds in the dark with high affinity to a site that structurally interacts with the primary electron acceptor FeQ/sub A/$^-$. Binding in the dark to this acceptor site causes conversion of the normal g = 1.9 EPR signal for FeQ/sub A/] to g = 2.1 on the first turnover. These results indicate that the binding site for NH_2OH overlaps with or interacts with the binding site for Q/sub B/. The EPR microwave power saturation of the g = 2.1 signal at 5.5 K is similar to that found for the endogenous ferrosemiquinone acceptors. These results indicate a structural change in the primary acceptor site upon binding NH_2OH, with no change in oxidation state of the iron or the semiquinone. In contrast, NH_2OH does not bind in the dark to PSII centers exhibiting the other major form of the primary acceptor, which exhibit the g = 1.82 EPR signal, since no change in the EPR signal is observed. The authors also find that the high-affinity binding of NH_2OH within the WOC produces no observable EPR-active products in the dark. They conclude that this binding site is closely associated with manganese, since there exists no blockage in the photooxidation of other donors like high-potential cytochrome b_{559} or signal II (^{160}Tyr x D_1 protein).

21929 **One-step electrodeposition of polycrystalline CuInSe/sub 2/ thin films and their properties.** Pern, F.J.; Noufi, R. (Solid State Research Branch, Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

Polycrystalline CuInSe/sub 2/ thin films have shown promise as a stable semiconductor material for producing high efficiency solar cels. For achieving low-cost, large area production of CuInSe/sub 2/ thin films, electrodeposition is an attractive process with high efficiency in material use and scalability. There has been significant efforts devoted in electrodepositing CuInSe/sub 2/ thin films with varied degree of success. In this paper, the authors discuss their efforts in the development of the one-step electrodeposition process. Effects of postannealing conditions and chemical treatments will also be described.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 21947

21930 **(DOE/AL/38869—T3) Establishment of a photovoltaic laboratory at the University of Lowell: Final report.** (Lowell Univ., MA (USA)). [1989]. Contract FG04-86AL38869. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009040/JAW.

The goal of this project was to move laboratory equipment from the MIT Lincoln Laboratory and install a photovoltaic systems laboratory at the University of Lowell. The project was later extended twice: first to include initiation of education and evaluation projects, and second to work with Enersol Associates to produce a report on rural electrification in the Dominican Republic.

21931 **(EPRI-GS—6251) Photovoltaic field test performance assessment, 1987: Final report.** Stokes, K.W. (Electric Power Research Inst., Palo Alto, CA (USA); Southwest Technology Development Inst., Las Cruces, NM (USA)). Mar 1989. 146p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

Under contract to the Electric Power Research Institute (EPRI), the Southwest Technology Development Institute analyzed the performance, operation and maintenance of four large photovoltaic plants for calendar year 1987. The plants examined were the City of Austin's plant in Austin, Texas, Arco Solar's plant near the Lugo substation in Hesperia, California, Sacramento Municipal Utility District's PV1 and PV2 systems in Sacramento County, California, and Arizona Public Service Company's Sky Harbor plant in Phoenix, Arizona. Hourly data were obtained from each plant's data acquisition system and calculations made of the following: Energy production, System ratings, normalized to standard conditions used in the industry, Efficiency, Availability, Capacity factor. Operation, maintenance, and repair activities were examined by subsystem/component for the four plants, and unscheduled operation and maintenance costs were determined. 12 refs., 77 refs., 9 tabs.

21932 **(NEDOJ-P—8730) Marketing research on potential demands of photovoltaic systems.** (New Energy and Industrial Technology Development Organization, Tokyo (Japan)). Mar 1988. 126p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756489/JAW.

Applicable uses and the market size for photovoltaic (PV) systems were investigated taking into consideration the features and economics of such systems. As a result of computing representative usage examples together with the extent of potential demand for PV, 238 GW for the power source in private homes, 76 GW for green houses, 126 GW for sewage water treatment plants, 4 GW for schools and universities and others were estimated. For the greater number of PV systems already in actual use, non-cost factors acted as major determining factors when deciding on implementation. Promising uses (applicable ideas) seen from the standpoint of non-cost factors were studied in order to develop the PV system market and gain breakthrough for lowering future costs and increasing proliferation for such systems. When it comes to simultaneously decreasing costs and increasing demand for solar batteries in the coming days, it will be impossible to make an immediate transition from the present state of demand for public use and for special use to the final goal of demand as a power source in the home. There is a need for an intermediate demand that can bridge this gap. (13 figs, 9 tabs)

21933 **Transient thermal analysis of three fast-charging latent heat storage configurations for a space-based power system.** Stovall, T.K.; Arimilli, R.V. (Oak Ridge National Lab., Oak Ridge, TN (US); Mechanical and Aerospace Engineering Dept., The Univ. of Tennessee, Knoxville, TN (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889508.

A space-based thermal storage application must accept large quantities of heat in a short period of time at an elevated temperature. A model of a lithium hydride phase change energy storage system was used to estimate reasonable physical dimensions for this application which included the use of a liquid metal heat transfer fluid. A finite difference computer code was developed and used to evaluate three methods of enhancing heat transfer in the PCM energy storage system. None of these three methods, inserting thin fins, reticulated nickel, or liquid lithium, significantly improved the system performance. The use of a 95% void fraction reticulated nickel insert was found to increase the storage capacity (total energy stored) of the system slightly with only a small decrease in the system energy density (energy storage/system mass). The addition of 10% liquid lithium was found to cause minor increases in both storage density and storage capacity with the added benefit of reducing the hydrogen pressure of the lithium hydride.

1407 Solar Thermal Power Systems

21934 **(CONF-890433—4) Maintenance of brine transparency in salinity gradient solar ponds.** Hull, J.R. (Argonne National Lab., IL (USA)). 1989. Contract W-31109-ENG-38. 22p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003963/JAW.

From 4. Pacific rim coal conference; Cartagena, Colombia (3 Apr 1989).

Experience with maintenance of brine transparency during the more than eight years of operation of the 100 m^2 Research Salinity Gradient Solar Pond at Argonne National Laboratory suggests that, for many sodium chloride brines, algal growth may be readily curtailed by minimizing the phosphate content of the brine. The use of modest amounts of aluminum sulfate (<5 gm m/sup {minus}2/ yr{{minus}1}) to precipitate soluble phosphate has resulted in a reduction of the use of chlorine from 13 gm m/sup {minus}2/ yr/sup {minus}1/ to 2.8 gm m/sup {minus}2/ yr/sup {minus}1/, while maintaining good transparency in the pond brine. 20 refs., 3 figs.

21935 **(PNL-SA—15444) Low-temperature volumetric receiver concept.** Drost, M.K. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1988. Contract AC06-76RL01830. 16p. (CONF-8809312—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008245/JAW.

From AIChE summer national conference; Denver, CO, USA (21 Sep 1988).

This document describes an alternative solar central receiver concept that offers the potential for a substantial reduction in the cost of electrical energy. The concept consists of a low temperature volumetric receiver which supplies 1100{degree}F air to a Kalina cycle heat engine. Hot air can also be supplied to a packed bed of Dresser basalt where the hot air is used to heat the bed. The thermal energy stored in the bed can be extracted and supplied to the

Kalina cycle during periods of low insolation. Previous investigations of the volumetric receiver concentrated on high temperature applications. The results showed that the volumetric concept could be very efficient, but the receiver was expensive and there were significant technical problems. Areas of technical uncertainty included fiber durability, the feasibility of inducing a preswirl and cost effective applications. The use of the volumetric receiver to produce low temperature will avoid the problems identified in the high temperature studies. The attractiveness of the low temperature concept is enhanced by the availability of the Kalina cycle. This heat engine was developed as a bottoming cycle for Brayton and Rankine cycle power plants. The key feature of the Kalina cycle is its ability to efficiently utilize the energy in a relatively low temperature heat source. The combination of the low temperature volumetric receiver and the Kalina cycle is particularly interesting. 7 refs., 2 figs., 3 tabs.

21936 **(SAND—88-1693C) Improved operational performance of the Shenandoah Solar Total Energy Project.** Nelson, R.S.; Heckes, A.A. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 11p. (CONF-890436—9). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008577/JAW.

From American Society of Mechanical Engineers solar energy conference; San Diego, CA, USA (2 Apr 1989).

This paper presents the results of selected design modifications to the Shenandoah Solar Total Energy Project (STEP) at Shenandoah, Georgia. The manpower required to operate the plant was significantly reduced, the loss rate of heat transfer fluid was slowed, and the system reliability improved so that the plant currently performs as originally intended. The items that brought about the improved operation include a new control system, a steam superheater, a larger boiler tubesheet, and a pressurized expansion tank for the heat transfer fluid. The aluminized film on five solar collectors was replaced with silvered film to improve the reflectivity and to field test its survivability. 5 refs., 4 figs., 1 tab.

21937 **(SAND—88-1923C) Potential of advanced-design solar central receiver power systems.** Tracey, T.R.; Tyner, C.E.; Weber, E.R. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 7p. (CONF-890436—6). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005054/JAW.

From American Society of Mechanical Engineers solar energy conference; San Diego, CA, USA (2 Apr 1989).

Criteria for the analysis, design, and operation of solar central receiver (SCR) power systems using molten salt working fluids have been developed based on many years of experience. Important among these criteria are eliminating high stress in receiver tubes, minimizing trace heating and the number of valves, reducing system pressure, using simple and reliable pumps, simplifying control and startup, and minimizing scaleup risk. In this paper we discuss how a system using a falling film direct absorption receiver (DAR) and other advanced-design concepts may meet these criteria better than more conventional designs. In addition to the receiver, we have examined potential areas for simplification and improvement in the areas of the steam generator system (SGS), trace heating, valves, pumps, and piping. Finally, we have re-examined the potential benefits of system modularization, taking into account unique features of the DAR. Implementation of the many potential advanced- design concepts available from a DAR-based system will require substantial changes in conventional molten salt SCR designs. In this paper, we discuss the potential of these design changes and barriers to their implementation. Selection of these unconventional designs over their better established alternatives will require demonstration of their cost-effectiveness and long-term safety and reliability. 15 refs., 5 figs., 3 tabs.

21938 **(SAND—88-2407) The economic potential of a photovoltaic central receiver power plant.** Menicucci, D.; Kolb, G. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 17p. (CONF-890436—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE88017344/JAW.

From American Society of Mechanical Engineers solar energy conference; San Diego, CA, USA (2 Apr 1989).

The concept of a photovoltaic central receiver system has existed for about ten years, but was not seriously considered because of the high cost and marginal quality of the PV cells. Recent breakthroughs in PV cell efficiency and quality coupled with the design of low-cost heliostats has justified reconsideration of the concept. An economic analysis shows that small PVCR systems can probably produce electricity at cost-effective rates with a minimal capital investment. However, this analysis assumes that some significant technical problems can be solved. An experimental program has been developed to address these problems, and the preliminary results are encouraging. If successful, it is anticipated that the PVCR technology could be marketable within the next five years. 10 refs., 2 figs., 2 tabs.

21939 **(SAND—88-3072C) Design considerations for heat-pipe solar receivers.** Adkins, D.R. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 24p. (CONF-890436—5). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004037/JAW.

From American Society of Mechanical Engineers solar energy conference; San Diego, CA, USA (2 Apr 1989).

Heat pipes are being developed to transfer solar energy from the focal paint of a parabolic dish concentrator to the working fluid of Stirling engines. With these receivers, concentrated solar energy that is absorbed on the concave surface of a dome is removed by the evaporation of liquid sodium on the convex side of the dome. Vaporized sodium then condenses on an engine's heater tubes and transfers energy to the working fluid of the engine. The condensed sodium returns to the absorber surface where it is redistributed across the dome by the capillary action of a wick. Issues concerning the flow of sodium in a heat pipe solar receiver are investigated in this paper. A comparison is made between various wick options, and general issues concerning the design of heat pipe receivers are also discussed. 25 refs., 7 figs., 2 tabs.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 21945, 22353, 22375, 22376, 22377, 22380, 22427, 22429

21940 (NP—9770326, pp 135-142) **Pilot project: Solar roof collector.** Brandau, H. [1984]. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770326/JAW.

In Agriculture in Hessen. Hessian Land programme for promoting the development of renewable energy sources and their use in agriculture.

This cereal drying and ventilation system with solar collector air preheating was planned by the farm owner himself. The blower used is pressure-tight and has an adequate capacity. The air feed however is seriously inhibited because of - the blower arrangement on the main duct with an air blower pointed vertically downward - an intake duct with a small diameter and only vertically arranged guiding devices which have no guiding vanes - the resistance of the pinholed foil. The air collector is sufficiently large for the air-preheating demand. With changing radiation intensity however, the preheating temperature is difficult to control.

21941 **(PIRSEM—1104) Climatic models applied to building energy system design: ARC.** Benard, C. (Centre National de la Recherche Scientifique, 75 - Paris (France). Programme Interdisciplinaire de Recherche sur les Sciences pour l'Energie et les Matiernes Premieres (PRISEM); Paris-11 Univ., 91 - Orsay (France)). 1986. 42p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757218/JAW.

Simple linear models are developed here to predict the d day solar irradiation from the (d-1) day meteorological data and the (d-1/d) night meteorological data (temperature, pressure, nebulosity, vapour tension of water, humidity, wind direction and speed, and solar irradiation data). The model is applied to the optimal design and the optimal control of a building space heating system with solar energy input (thermal walls, dynamic insulation systems, etc.).

21942 **(SAND—89-0134C) Modeling of a catalytically enhanced solar volumetric absorption chemical reactor.** Skocypec, R.D.; Hogan, R.E. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 15p. (CONF-890321—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009534/JAW.

From Spring meeting of the Western States Section of The Combustion Institute; Pullman, WA, USA (20 Mar 1989).

The catalytically enhanced solar absorption receiver (CAESAR) volumetrically absorbs concentrated solar energy throughout a catalyzed porous absorber matrix volume, promoting the heterogeneous carbon dioxide reforming of methane. There are a number of applications for this concept, including thermochemical energy transport, methanol production, and the destruction of certain classes of hazardous chemical waste. A numerical model of these reactors has been developed to provide guidance in the catalytic matrix design for CAESAR, to evaluate the reactor performance, and to evaluate test data. The effects of varying the incident solar flux, the fluid mass flow, the convective heat transfer coefficient, and the solar and infrared optical thicknesses on the thermal and chemical characteristics are presented. Based on a prototype absorber and anticipated operating conditions for CAESAR, model results suggest the mass flux must be proportioned to the incident solar flux radial distribution to prevent unacceptably high local temperatures and provide a reactor having more uniform exit conditions. Either the catalytic loading or geometric thickness of the absorber should be increased for conversion to approach equilibrium levels. Also, the optical density of the matrix (particularly at the sunlit side of the reactor) should be decreased to distribute solar energy more uniformly and decrease matrix temperatures at the front of the absorber. 6 refs., 9 figs., 3 tabs.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 22384, 22827

21943 **(EIR—609) Corrosion of circuit materials in three solar heating plants under operating conditions.** Wiedemann, K.H. (Paul Scherrer Inst. (PSI), Wuerenlingen (Switzerland)). Jan 1987. 26p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757381/JAW.

The coolant of the flat collector circuit of the EIR solar heating plant OASE has been controlled for 50 months. The progress or state of corrosion on circuit materials cannot be recorded by p/sub H/-measurements, electrical conductivity readings or by chemical analysis of coolant samples. The metal losses of material samples after 3 years in a circuit by-pass were particularly high on aluminium (ca. 70 μm), due to an inappropriate inhibitor used in the coolant. The metal losses mentioned appeared within ca. 6 months and then remained almost constant, due to the building up of a corrosion preventing layer. Material samples in circuit bypasses of two solar heating plants of two apartment houses with a proprietary brand coolant showed no or only neglegible metal losses. Pitting corrosion was not observed on any of the materials examined. (orig./BWI).

21944 **(SAND—88-1651C) An assessment of the optical performance of stretched-membrane mirror modules.** Alpert, D.J.; Houser, R.M. (Sandia National Labs., Albuquerque, NM (USA)). [1988]. Contract AC04-76DP00789. 16p. (CONF-890436—2). NTIS, PC A03/MF A01 - OSTI; GPO Dep. Order Number DE88017347/JAW.

From American Society of Mechanical Engineers solar energy conference; San Diego, CA, USA (2 Apr 1989).

The United States Department of Energy's solar thermal program is developing an innovative concept for the heliostats used in a solar central-receiver power plant: replacing the familiar glass mirrors with stretched-membrane reflectors. This paper presents Sandia's assessment of first- and second-generation mirror modules made of stretched membranes. The first of these prototype mirror modules were built in 1986 by two contractors to Sandia. Solar Kinetics, Inc., produced a module with optical characteristics equaling those of heliostats that use glass mirrors. The first design produced by Science Applications International Corp. proved to be unworkable. Using the experience gained with the first models, the same two contractors are currently building improved prototypes. The improved designs will be easier to fabricate and will perform better than the first-generation designs. SAIC's second design has been installed at the Central Receiver Test Facility, and Sandia's preliminary assessment shows the quality of its beam to be as good as SKI's original design. SKI is currently in the process of installing its second prototype. The final paper will include detailed results of the second-generation prototypes' beam quality, focusing systems, defocusing capabilities, and durability. 23 refs., 6 figs.

21945 **(SAND—88-1847C) Comparison of a cavity solar receiver numerical model and experimental data.** Hogan, R.E.; Diver, R.B.; Stine, W.B. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-890436—3). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003609/JAW.

From American Society of Mechanical Engineers solar energy conference; San Diego, CA, USA (2 Apr 1989).

A numerical model which predicts the thermal environment in axisymmetric solar cavity receivers is described. The computed energy transfer rates and temperatures are compared to experimental data for tests of a novel test bed receiver in the Sandia National Laboratories solar furnace. In general, the numerical model captures the trends observed in the experimental data. Sensitivity analyses show that the total solar energy input rate and the convective heat loss coefficient have a significant effect on the thermal performance and that the input solar flux distribution has a significant effect on the receiver temperature distribution in these experiments. 16 refs., 5 figs., 2 tabs.

21946 **(SAND—88-7035) Development of a stretched membrane dish: Phase 1.** (Sandia National Labs., Albuquerque, NM (USA); Solar Kinetics, Inc., Dallas, TX (USA)). Mar 1989. Contract AC04-76DP00789. 189p. NTIS, PC A09/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009640/JAW.

A stretched-membrane dish concentrator design was developed in Phase I of a contract directed by Sandia National Laboratories, Albuquerque. The concentrating optical element was investigated in detail, and conceptual designs were provided for the collector support system. The optical element was defined by a monolithic, single-facet, parabolic design with an f/D ratio of 0.6. The conceptual support system was a hub and spoke structure similar to a bicycle wheel. The estimated optical element weight was 2.3 lb/ft² (11 kg/m²), and 6.6 lb/ft² (32 kg/m²) for the entire collector. A 0.010 in. (0.25-mm) thick aluminum diaphragm was plastically deformed without the use of a mold or mandrel to create the optical membrane. This free-form yield process was demonstrated with 1.4-m and 3.7-m diameter tests. The one-sigma slope error of these test membranes, based on a peak flux bound, was less than 2 mrad at the smaller scale, and less than 4 mrad at the larger scale. The aluminum membrane defined the concentrator shape for a separate, reflective polymer film membrane. Contact between the two membranes was maintained with a vacuum. The stretched-membrane dish technology, applied to a parabolic dish, demonstrated the potential for high performance with low weight. 33 refs., 56 figs., 7 tabs.

21947 **Reflux heat-pipe solar receivers for dish-electric systems.** Andraka, C.E.; Diver, R.B. (Sandia National Labs., Albuquerque, NM (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889213.

In the reflux (i.e. gravity assisted) heat pipe receiver, concentrated solar radiation causes liquid metal (sodium, potassium, or NaK) to evaporate. The vapor flows to the engine interface heat exchanger, where it condenses and releases the latent heat. The condensate is returned to the receiver absorber by gravity (refluxing), and distributed over the surface by gravity and/or capillary forces in a wick lining the receiver. It is essentially an adaptation of heat pipe technology to the peculiar requirements of concentrated solar flux, and provides many advantages over conventional heated tube receiver technology. This overview paper describes the cur-

rent status and future plans for the U.S. Solar Thermal Program reflux receiver development program at Sandia National Laboratories. Current work includes conventional mesh wick receivers, sintered metal wicks, and pool boiler receivers. The relative design merits and concerns of the different approaches and technology development test plans are discussed.

1420 Heat Storage

REFER ALSO TO CITATION(S) 21933, 22258, 22259

15 GEOTHERMAL ENERGY

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 21956, 23251

21948 **(EUR—11669) Proceedings of a contractors' meeting/workshop on 'Geochemistry'.** Louwrier, K.; Garnish, J. (eds.). (Commission of the European Communities, Luxembourg. Directorate-General for Science, Research and Development). 1987. 194p. (CONF-8711292—). Commission of the European Communities, 200 Rue de la Loi, 1040 Brussels, Belgium.

From Contractors' meeting/workshop on geochemistry; Toulouse, France (24 Nov 1987).

Concentrations of organic compounds in geothermal vapors can give information about the temperature in the deep reservoir where equilibria between these compounds are formed. An application of this approach is given for Larderello. The work presented in this workshop is the continuation of that presented previously in Antwerp. These workshops bring together the scientists who work on similar problems under contract to the Commission of the European Communities. Meetings like these are important for the mutual information of the participants and for the strengthening of international cooperation. The Commission of the European Communities has been involved in research, development and demonstration of geothermal energy since 1975. Chemistry is an important aspect of this research. It enters at many levels in the process of extracting heat from the sub-soil. Water-rock interaction is important in the Hot Dry Rock technology where water is pumped through a man-made fracture system in a rock that has otherwise virtually no water circulation. Natural deep ground waters that are of interest for geothermal developments often contain considerable amounts of salts that may precipitate at lower temperature or pressure. This leads to scaling during the production of hot water or steam.

21949 **(NEDOJ-P—8710) Survey concerning introduction of new geothermal prospecting methods (part 2).** Koshikawa, Fumio; Takakura, Tsuyoshi; Kaneko, Minoru; Hasuike, Hiroshi; Takabe, Ayako. (New Energy and Industrial Technology Development Organization, Tokyo (Japan)). Mar 1988. 166p. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756482/JAW.

Based upon the results of the survey in FY 1986, the survey in FY 1987 was conducted with the objectives to determine and assess the technical contents of the new prospecting techniques recently developed or under development and study the feasibility of its application to Japan, etc. in order to improve the accuracy and efficiency during the prospecting of underground geothermal reservoirs from the surface of the earth. An underground area where the natural geothermal steam and hot water exist is called a geothermal reservoir. Concepts concerning the patterns of geothermal reservoirs have changed greatly in the past 10 years. Recently it has been revealed that many of them are fractured reservoirs. Because of this, underground fractures have become very important throughout the processes of prospecting and assessment of reservoirs. Taking into consideration these trends, this survey was prepared by utilizing papers and reports, most of which had already been published including certain overseas surveys. (42 figs, 12 tabs, 96 refs)

1504 Legal And Institutional Aspects

21950 **(NEDOJ-P—8732) Research on the vision for introducing the utilization of the geothermal resources.** (New Energy and Industrial Technology Development Organization, Tokyo (Japan)). May 1988. 226p. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88756490/JAW.

This survey is performed for the purpose of investigating the applicability and practical use of geothermal energy as a domestic and non-exhaustive energy, and also to provide materials for future technological development, and measures for its introduction. The survey is designed to follow on from the survey implemented in 1986. As for topics for promoting the development of geothermal resources, problems concerning the related regulations, development system, conditions for technological development, environmental problems and the problem of the influence on hot springs were studied. As for outlines of the system for geothermal resource utilization, geological and physico-chemical classification was made for the geothermal resource and research and basic survey materials were compiled for items related to the design and manufacture of the equipment for the utilization facilities, and for aspects relating to operation safety. The selection of representative types of the generating facilities, was performed so that the optimum system could be designed, while the power generation system of the portable type was evaluated, in view of the lower costs involved. The above results of the basic survey were used to perform outline designs for the four cases which are power generation 30000 kW, 3000 kW, 100 kW and heat utilization 75°C, 480 t/h. (67 figs, 18 tabs, 12 refs)

1505 Economic And Financial Aspects

REFER ALSO TO CITATION(S) 21950

1506 Environmental Aspects And Waste Disposal

REFER ALSO TO CITATION(S) 21948, 21950

21951 **(SAND—89-0504C) The role of geothermal energy in minimizing global environmental problems.** Traeger, R.K. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 4p. (CONF-890352—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008685/JAW.

From US Department of Energy research and development for the geothermal marketplace: 7th geothermal program review; San Francisco, CA, USA (21 Mar 1989).

Two current global environmental concerns discussed in this paper are the "greenhouse effect" and acid rain. Both of these areas have been emphasized by President Bush, and legislation is pending in both state and federal legislatures to address these problems. We need to understand the impact of geothermal energy production in these areas and, from a DOE viewpoint, identify R and D that is critical to meeting existing and pending regulations and laws. 8 refs., 5 figs., 5 tabs.

1508 Geothermal Power Plants

REFER ALSO TO CITATION(S) 21950

21952 **(DOE/ID/12477—1) Preconstruction of the Honey Lake Hybrid Power Plant: Final report.** (Geoproducts Corp., Oakland, CA (USA)). 30 Apr 1988. Contract AC07-84ID12477. 50p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009145/JAW.

The work undertaken under this Contract is the prosecution of the preconstruction activities, including preliminary engineering design, well field development, completion of environmental review and prosecution of permits, and the economic and financial analysis of the facility. The proposed power plant is located in northeastern California in Lassen County, approximately 25 miles

east of the town of Susanville. The power plant will use a combination of wood residue and geothermal fluids for power generation. The plant, when fully constructed, will generate a combined net output of approximately 33 megawatts which will be sold to Pacific Gas and Electric Company (PG&E) under existing long-term power sales contracts. Transfer of electricity to the PG&E grid will require construction of a 22-mile transmission line from the power plant to Susanville. 11 refs., 12 figs., 4 tabs.

1509 Geothermal Engineering

21953 **(DOE/SF/15490—T1) Heber geothermal coupon analytical report: [Final technical report].** (Radian Corp., Austin, TX (USA)). 20 Oct 1986. Contract AC03-85SF15490. 12p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009101/JAW.

The objectives of this paper are: to determine the cause of accelerated metal loss from the loading edges (as relates to brine flow) of carbon steel coupons in the low temperature portion of the Heber brine loop; and to clarify the reason for the distinctly different morphology of attack on the A53B pipe steel compared to the sheet 1018 steel. 6 figs.

21954 **(NEDOJ-P—8712) Experimental survey on geothermal well drilling for improvement of the drilling work efficiency.** (New Energy and Industrial Technology Development Organization, Tokyo (Japan)). May 1988. 189p. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88756483/JAW.

In order to reduce the geothermal well drilling cost which amounts to 40 to 60 % of the total geothermal energy development cost, various factors relevant to the drilling operation have been extracted and examined, aiming at the reduction in the well drilling time which is the most definite factor for the well drilling cost. The following items have been studied on their current situations: drilling time analysis on 13 geothermal wells drilled by NEDO; questionare to 9 domestic geothermal developer enterprises to obtain information on their bussiness status; to investigate current activities of 5 geothermal well drilling companies in U.S.A. and Italy. Investigations of countermeasures for improving well drilling work efficiency, such as reducing the time of rig-up and rig-down, prevention and countermeasures against borehole troubles, improvement of rate of penetration have been carried out. Furthermore, investigations of organization for well drilling work such as education and training of drilling crew and secure of drilling supervisors have been conducted. Having summerized the items examined for improving the geothermal well drilling efficiency, the goals of improvement of the efficiency and the future tasks in the mainly technical aspect are extracted. Example of the content is as follows, shortening rig-up and down time set to less than 15 days for rig-up and less than 10 days for rig-down, by securing drilling site area. (50 figs, 13 tabs, 13 refs)

1520 Geothermal Data And Theory

21955 **(CONF-881045—7) The dynamics of silica deposition in fractures: Oxygen isotope ratios in hydrothermal silica from Yellowstone drill core Y-13.** Sturchio, N.C.; Keith, T.E.C.; Muehlenbachs, K. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007500/JAW.

From Annual meeting of the Geothermal Resources Council; San Diego, CA, USA (9 Oct 1988).

The $\delta^{18}O$ values of 22 samples of hydrothermal chalcedony and quartz from Y-13 drill core range from {minus}7.5 to {minus}1.3{per←thousand}. Most samples could not be in mineral-water isotopic equilibrium under present conditions. Fluid inclusion homogenization temperatures in quartz indicate precipitation at or above temperatures measured during drilling. Most silica appears to have precipitated from water enriched in ^{18}O relative to present thermal water. Inferred ^{18}O enrichments are too large in many cases to be explained by boiling and steam separation. The apparent ^{18}O enrichment in thermal water may represent a transient dynamic effect that occurs when new fractures open, as disequilibrium increases and the local system is temporarily perturbed. This interpretation is consistent with the observed sequence of mineral deposition and $\delta^{18}O$ within individual fractures. 32 refs., 2 figs., 2 tabs.

21956 **(LA-UR—89-930) Hot Dry Rock geothermal reservoir model development at Los Alamos.** Robinson, B.A.; Birdsell, S.A. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 18p. (CONF-890352—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009285/JAW.

From US Department of Energy research and development for the geothermal marketplace: 7th geothermal program review; San Francisco, CA, USA (21 Mar 1989).

Discrete fracture and continuum models are being developed to simulate Hot Dry Rock (HDR) geothermal reservoirs. The discrete fracture model is a two-dimensional steady state simulator of fluid flow and tracer transport in a fracture network which is generated from assumed statistical properties of the fractures. The model's strength lies in its ability to compute the steady state pressure drop and tracer response in a realistic network of interconnected fractures. The continuum approach models fracture behavior by treating permeability and porosity as functions of temperature and effective stress. With this model it is practical to model transient behavior as well as the coupled processes of fluid flow, heat transfer, and stress effects in a three-dimensional system. The model capabilities being developed will also have applications in conventional geothermal systems undergoing reinjection and in fractured geothermal reservoirs in general. 15 refs., 7 figs.

21957 **(LBL—26509) On relative permeability of rough-walled fractures.** Pruess, K.; Tsang, Y.W. (Lawrence Berkeley Lab., CA (USA)). Jan 1989. Contract AC03-76SF00098. 11p. (CONF-890114—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008169/JAW.

From 14. workshop on geothermal reservoir engineering; Stanford, CA, USA (24 Jan 1989).

This paper presents a conceptual and numerical model of multiphase flow in fractures. The void space of real rough-walled rock fractures is conceptualized as a two-dimensional heterogeneous porous medium, characterized by aperture as a function of position in the fracture plane. Portions of a fracture are occupied by wetting and non-wetting phase, respectively, according to local capillary pressure and accessibility criteria. Phase occupancy and permeability are derived by assuming a parallel-plate approximation for suitably small subregions in the fracture plane. Wetting and non-wetting phase relative permeabilities are calculated by numerically simulating single phase flows separately in the wetted and non-wetted pore spaces. Illustrative examples indicate that relative permeabilities depend sensitively on the nature and range of spatial correlation between apertures. 30 refs., 7 figs., 1 tab.

17 WIND ENERGY

21958 **(NRC/E—TM-WE-005) Canadian research and developpment program in wind energy. Overview and progress report.** Chappell, M.S. (National Research Council of Canada, Ottawa, Ontario. Div. of Energy). 1981. 60p. (In French). (MICROLOG—88-04459). National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, Ont., Canada K1A 0R6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Canadian wind energy research began in the Low Speed Aerodynamics Laboratory at the National Research Council in 1966. The first efforts, oriented toward low-power systems for use in remote areas, have led to the reinvention of the vertical axis Darrieus turbine, first patented in 1927. After the 1973 oil crisis, the various research and development activites were regrouped into one overall federal program on renewable energy. Research was conducted into larger-scale systems capable of supplying energy at competitive cost. The vertical-axis turbine has these qualities and remains the pillar of the Canadian program. Elements of this program are: evaluation of wind resources and wind power sites; research and development of wind power technology; and field ex-

perimentation on technology transfer. Studies show that the vertical axis turbine of 1-MW range constitutes the best option for economical production of electricity on utility scale. Eole, a joint project of the Council and Hydro-Quebec leading to the design, construction and evaluation of such a wind power system, will permit the confirmation of design methods and the acquisition of experience on the operation of such a system on a real scale. 25 refs., 10 figs., 6 tabs.

1706 Wind Energy Engineering

21959 **(ECN—89-019) Control strategies for an electrical conversion system for Flexhat. The synchronous generator with an active DC intermediate stage.** De Bonte, J.A. (Netherlands Energy Research Foundation, Petten). Jan 1989. 15p. (In Dutch).

Within the framework of the Dutch National Development Program Wind Energy the Flexhat project is carried out. One of the sections in the project is Control and Electric Conversion Systems. One of the tasks in this section is to make an inventory of electric conversion systems which can operate at variable speed. From the inventory two systems were selected to be applied in Flexhat configurations within the 500 kW capacity range: the synchronous generator with active DC intermediate stage, and the asynchronous generator with condensator excitation and active DC intermediate stage. Control strategies for the first system are indicated as well as the requirements for the control regulations. Also it is determined which control regulations are most appropriate for application in the Flexhat project. 6 figs., 1 ref., 1 tab.

21960 **(EPRI-GS—6256) Assessment of wind power station performance and reliability: Final report.** Lynette, R. (Electric Power Research Inst., Palo Alto, CA (USA); Lynette (R.) and Associates, Inc., Redmond, WA (USA)). Mar 1989. 105p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

The use of wind power stations to generate electricity represents a new technology for the utility industry. Little is known about long-term energy production, equipment availability, and operation and maintenance (O and M) costs. The objective of this report is to present the results of an assessment of the available field experience to date, at a number of wind turbine sites. The data reported cover 1986 and 1987 field experience, but insight from previous years' experience was utilized to draw conclusions and make recommendations regarding wind turbine reliability. Operational information was collected and assessed from fifteen commercial wind power stations. The data cover twelve different wind turbine models. Results are presented for the current experience and some projections are made for future large wind power stations. Energy production predictions for planned wind power stations are imprecise, due to the as-yet unresolved problems associated with micrositing and array effects. However, according to statistics prepared by the California Energy Commission, the commercial wind power stations in California are achieved approximately 50% of the energy production expected when the machines were installed. Although there are some exceptions (i.e, some stations are meeting projections), the energy shortfall poses a serious problem for the industry. Long-term equipment availability and O and M costs are not well established, due to insufficient historical data. The fatigue life of wind turbine structural components may be significantly shorter than expected. In cases where fatigue failures are already evident (i.e., rotor blades, gearboxes, and yaw systems), the challenge is to improve designs and upgrade quality control procedures without substantial cost increases. 15 figs., 21 tabs.

21961 (NP—9770326, pp 122-128) **Pilot project: Wind energy.** Ruch, T. [1984]. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770326/JAW.

In Agriculture in Hessen. Hessian Land programme for promoting the development of renewable energy sources and their use in agriculture.

This project was carried out in one of the Hessian areas with the highest incidence of wind. Wind velocities and reliability of wind directions however were not sufficient to bring about a satisfactory annual output. The calculated planning figures bear witness to the fact that wind energy is not a viable source of energy for Hessen at the present moment or in the near future. This alternative energy could only be made economical if considerable cheaper equipment were available.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 21610, 21621, 21621, 21650, 21667, 21668, 21952, 22006, 22752, 22821, 22825, 22827

21962 **(DOE/FE—0124) Report to Congress: A study comparing the cost and performance of first and second generation integrated gasification combined cycle systems.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC). Apr 1989. 55p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008953/JAW.

A prior generic study had been conducted by the Department of Energy assessing second generation IGCC system configurations that achieve better economics and fuel conversion efficiency than first generation systems typified by the Cool Water IGCC demonstration project. Also, the Electric Power Research Institute (EPRI) commissioned a site specific study to evaluate the technical feasibility and economic competitiveness of first generation IGCC systems from an end user perspective. The EPRI study is being conducted by Southern Company Services, Inc. (SCS) and the site targeted for investigation was Georgia Power Company's Plant Wansley located near Atlanta, Georgia. This study contains a review of prior studies and the status of the SCS study. To assure direct comparability between first and second generation cost and performance results, this site specific study will be conducted using the same site and the same assessment methodology as was used in a previous site specific study of a first generation system conducted by SCS for EPRI. The first generation system used in this previous study included an oxygen-blown fluidized bed gasifier, cold gas cleanup and conventional gas and steam turbines. Seven second generation systems employing the advanced technology listed above will be assessed for the effects of changes in plant size, gasification configuration, turbine configuration and desulfurization configuration on plant performance and economics. This study will also include a comparison of performance and economics with a conventional pulverized coal-fired power plant with flue gas desulfurization. 5 figs.

21963 **(EPRI-CU—6279) Proceedings: Advanced adjustable speed drive R and D planning forum.** McCleer, P. (Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA)). Mar 1989. 276p. (CONF-8711294—Summ.). Research Reports Center, Box 50490, Palo Alto, CA 94303.

From Advanced adjustable speed drive R&D planning forum; Research Triangle Park, NC, USA (30 Nov 1987).

A requirement essential to the advancement of ac adjustable speed drive technology is well-balanced progress of various element technologies -- motors, devices, converters, sensors, materials, modern controls, and microcomputers. This report presents the results of an effort by the Electric Power Research Institute: (a) to better understand the impact of element technologies on one another and (b) to identify the research needed to develop these base technologies. At the R and D Planning Session held November 30 to December 2, 1987, in Research Triangle Park, NC, representatives from industry, utilities, academia, national laboratories, and trade associations met to explore the interplay, impact, and future trends and research needs of such element technologies on ac adjustable speed drives. The results indicate that a balanced approach across a broad front of inter-related technology development should be adopted. Manufacturing technologies advancement is necessary to fill the big gap that exists between research and commercialization. Market research, database development, application development, and application guidebooks are some of the other recommendations. This proceedings describe in detail the present state and future trend of the base technologies, the market and applications, and the various R and D needs.

21964 **(EPRI-GS—6203) Heat exchanger tube coatings and liners: Final report.** (Electric Power Research Inst., Palo Alto, CA (USA); Stone and Webster Engineering Corp., Boston, MA (USA)). Mar 1989. 143p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

Because of wall thickness loss from pitting and general or inlet-end erosion/corrosion, condenser or heat exchanger retubing is a common and expensive corrective measure. Full-length and inlet-end tube coatings, metallic, inserts, and full-length metallic liners were evaluated at Manchester Street Station's bearing water coolers and test heat exchanger for the purpose of extending the life of the tubes. All but one of the treatments tested were developed to be retrofitted in situ lieu of retubing. For convenience, the full-length coatings were shop applied for the tests. The evaluation consisted of in situ inspections of the coatings and tubes, in situ heat transfer measurements, and laboratory accelerated erosion tests. Capital cost estimates were prepared for the treatments and an economic analysis also was performed to compare the cost benefits of retubing versus full-length coatings. The analysis was performed using the Brayton Point Station - Unit 2 condenser. Results indicate that some full-length coatings have little effect on heat transfer, have a longevity of over 10 years (dependent on the service conditions), and can be used to protect tubes from corrosion and possible biofouling. Some coatings, however, blistered and delaminated incompatible coating filler material, which was possibly due to improper application procedures. Liners were found to substantially reduce heat transfer, but can be used to restore plugged tubing. Inserts and inlet-end coatings can protect the tubes from inlet-end erosion/corrosion. Metal inserts can provide structural integrity to the tube inlets, but can result in tube erosion downstream of the inserts. Inlet-end coatings can be tapered smoothly to prevent tube erosion, but do not provide any structural strength. 15 refs., 52 figs., 13 tabs.

21965 **(EPRI-GS—6252) Survey of water-conserving heat rejection systems: Final report.** Mitchell, R.D. (Electric Power Research Inst., Palo Alto, CA (USA); Sierra Pacific Power Corp., Reno, NV (USA)). Mar 1989. 199p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report presents the results of a survey of water conserving power plant heat rejection systems. Complete characterization of the currently available alternative water conserving heat rejection systems are provided, their applicability for use in meeting a range of power plant water use and environmental constraints is outlined, and additional research needs are identified. The objective of this project was to develop a comprehensive and consistent information base on water conserving heat rejection technology which would provide utilities with an effective tool for first-order planning when dealing with changing water availability. 63 refs., 19 figs., 6 tabs.

21966 (IEIE—8801, pp 29-32) **Development of superconducting generator and effect of its installation in power system.** Kurihara, Shiro; Tsukamoto, Naomi; Ueda, Kiyotaka; Sunada, Masakazu. (Agency of Industrial Science and Technology, Tokyo, Japan; Yokohama National Univ., Yokohama (Japan)). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—(Pt.1)).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

Rapid advance in superconducting material development and the introduction of superconducting wires usable for AC have caused the development of superconducting materials for power generator to attract attention. This paper outlines feasibility study on technology related to superconducting power generation. This subject is intended to implement the national project which will proceed for over eight years from 1988. The purpose of this study is to clarify future conceptual design of superconductive generators based on the past conceptual design. The performance of slow response generator (A), slow response generator (B), and 200,000 KW class very quick response generator was analyzed. Then, model and pilot generators were fabricated and tested to make a research and development plan. (10 figs, 2 refs)

21967 (IEIE—8801, pp 33-36) **Technology for cooling superconductive generator rotors.** Toyama, Sakutaro. (Electrotechnical Lab., Tsukuba, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—(Pt.1)).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

Technical subjects for cooling superconducting generators are (1) safe and steady cooling of conductor in generator rotor machine, (2) cooling in non-steady condition, and (3) system configuration with high reliability. This paper reviews these three subjects in the light of the present technology and outlook. As for constant cooling, though requirements are almost satisfied equipmentally, application to large equipment is difficult and must be studied. As for cooling in non-steady condition, the subject is to provide uniform cooling in the rotor chamber with as a short turning as possible. As for reliability, the introduction of artificial intelligence to reduce operator's work load and high precision measurement is necessary. There is still room for study in this field. (6 tabs)

21968 (IEIE—8801, pp 37-40) **Research and Development of construction material for superconducting generator.** Hirano, Kazumi. (Mechanical Engineering Lab., Ibaraki,, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

For the development of superconductive generators, study of construction materials is important as well as that of superconducting materials. The most important factor in this study is fatigue characteristic depending on repeated thermal strain and electromagnetic force. This paper outlines the trend of research and development of these characteristics and construction materials for extremely low temperature to describe the subject for the future. Recommended construction material must endure the use from normal to extremely low temperature at high speed of rotation. Various materials are being examined. For miniaturization and high energy density, use of Nb_3Sn wire material is also studied. As composite materials, metal and organic material are studied and three-layer damper structure is also studied. For the future, development of new material and establishment of design standard of equipment structure is necessary. (7 figs, 2 tabs)

21969 (IEIE—8801, pp 41-43) **Superconducting generator rotors and material development. Superconducting metal development for superconducting generators.** Iwamoto, Masatami; Yamada, Tadatoshi. (Mitsubishi Electric Corp., Tokyo, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

This paper summarizes development condition of elemental technology in metal superconductive material and technology necessary for the field coil of superconducting generators. For application and accomplishment of elemental technology of metal superconducting material, NbTi alloy and Nb_3Sn compound are examined. For high density current, no design theory for determining the coil current density necessary for superconducting generators has been established yet. The necessity of pulse superconducting material, methods of supporting and fixing the coil against centrifugal and electromagnetic force, and the required coil current are examined. From the analysis of these examinations, various requirements and subjects are presented on the development of superconducting metals for better superconducting generators. (2 tabs, 3 refs)

21970 **(LBL—25782) Program experience report: Commercial cool storage.** Piette, M.A.; Harris, J.P. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 21p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008856/JAW.

This paper reviews, compares, and documents actual experience with utility and non-utility programs desired to encourage the use of commercial cool storage technologies. Such information will

help guide future demand-side programs, and help utility planners anticipate program-related penetration rates (and other impacts) of demand-side resources. This work is a companion document to a larger report that discusses the technology itself. This report is part of a series of program experience reports by the Lawrence Berkeley Laboratory (LBL) designed to synthesize current information on demand-side resources from both published and unpublished sources. 35 refs., 3 tabs.

21971 **Load control experiments with heat pumps during the winter.** Reed, J.H.; Broadwater, R.P.; Chandrasekaran, A. (Oak Ridge National Lab., Energy Div., Oak Ridge, TN (US); Center for Electric Power, Tennessee Technological Univ., Cookeville, TN (US)). *IEEE Transactions on Power Delivery;* **4**: No. 1, 646-652(Jan 1989).

The Athens Automation and Control Experiment is a hardware and software-oriented research and development project installed on the Athens Utilities Board's distribution system in Athens, Tennessee. The basic purposes of the experiment are to automate the distribution system and to develop and implement control strategies that improve the efficiency and controllability of the distribution system. A series of load management experiments have been performed in which individual appliance and household measurements have been taken. The focus of this paper is on load control experiments performed on heat pumps during the winter. The data indicates that load control of heat pumps can result in a higher energy use for the heat pumps due to the operation of the auxiliary heat.

21972 **Distribution automation applications software for the Athens Utilities Board.** Rizy, D.T.; Lawler, J.S. (Power Systems Technology Program Energy Div., Oak Ridge National Lab., Oak Ridge, TN (US); Dept. of Electrical and Computer Engineering, Univ. of Tennessee, Knoxville, TN (US)). *IEEE Transactions on Power Delivery;* **4**: No. 1, 715-724(Jan 1989).

In this paper, the authors discuss the development of a distribution automation applications software package for assessing system reconfiguration opportunities and volt/var control on automated radial distribution feeders. The package, called SYSRAP (System Reconfiguration Analysis Program) was developed by the Oak Ridge National Laboratory as part of the Athens Automation and Control Experiment (AACE). The AACE is a large scale distribution automation research project being conducted on the Athens Utilities Board (AUB) in Athens, Tennessee. SYSRAP is unique because it combines power flow and short circuit analyses with data base management and is especially well suited for answering system operator questions with respect to switch orders, capacitor bank dispatch and regulator tap adjustments. The program runs on a personal computer, executes power flow and short-circuit analyses for detailed feeder models in tens of seconds, uses highly detailed feeder models including voltage sensitive loads, and is adept at reorganizing the data base to reflect switching operations and changes in the status of volt/var control equipment. Experimental observations on the AUB system have shown that voltage insensitive load models (constant power sinks) are inadequate to accurately simulate system response to system reconfiguration and volt/var control which affect feeder voltage profile.

21973 **Measuring and analyzing the impact of voltage and capacitor control with high speed data acquisition.** Rizy, D.T.; Lawler, J.S.; Patton, J.B.; Nelson, W.R. (Energy Div., Oak Ridge National Lab., Oak Ridge, TN (US); Dept. of Electrical and Computer Engineering, Univ. of Tennessee, Knoxville, TN (US); Consultant, Knoxville, TN (US); Energy Div., Oak Ridge National Lab., Oak Ridge, TN (US)). *IEEE Transactions on Power Delivery;* **4**: No. 1, 704-714(Jan 1989).

In this paper experimental results of the effects of capacitor switching on feeder operating variables as measured in the substation by a high speed data acquisition system are presented. Consistent with the modelling of feeder loads as constant power, the switching in of a capcitor bank to improve power factor results in decreased reactive power injection and increased phase voltages. However, contrary to constant power load modelling, a reduction in real power injection reflecting reduced line losses is not observable at the substation. In fact, the measured real power injection increases. Similarly, the switching out of a capacitor bank results in increased reactive power, decreased phase voltages and decreased real power.

21974 **Use of a general control simulation program.** Zhang, X.; Warren, M.L. (Lawrence Berkeley Lab., Berkeley, CA (US)). pp v of Proceedings of the American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. 1988 winter meeting. Volume 94, Part 1. Atlanta, GA; American Society of Heating Refrigeration and Air Cond. (1988). (CONF-880128—).

From ASHRAE winter meeting; Dallas, TX, USA (30 Jan 1988).

A general process engineering simulation program for a microcomputer is used to evaluate the response of a cooling system to changes in load, setpoint, and controller tuning parameters to better understand the control stability of a supply air cooling system used in the Mobile Windows Thermal Test (MoWiTT) Facility. A detailed system model is built out of standard components and is used to plot the steady state performance under different operating conditions. The response of the cooling coil output depends strongly on the transport delays. For a system with a linear control valve, the process gain of the cooling coil increases rapidly as the valve flow fraction decreases. A system that is stable at mid-range is shown to become marginally unstable at the low end of the control range. The applications of both an equal percentage valve and reheat are shown to improve the control response of the system under low cooling load conditions.

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REFER ALSO TO CITATION(S) 21643, 21644, 21650, 21664, 21689, 22418, 23060, 23065, 23066, 23069

21975 **(CONF-890402—2) Measurement of alkali vapor concentration in the PFBC [pressurized fluidized-bed combustion] flue gas.** Lee, S.H.D.; Carls, E.L. (Argonne National Lab., IL (USA)). 1989. Contract W-31109-ENG-38. 29p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005889/JAW.

From 10. international conference on fluidized-bed combustion; San Francisco, CA, USA (30 Apr 1989).

A laboratory-scale PFBC/alkali sorber unit has been used to measure the level of vapor-phase alkali in PFBC (9.2 atm absolute) flue gas. Prior to sampling with a hot (850--900{degree}C) stainless steel tube for alkali analysis, the flue gas was cleaned of particulates by use of a hot cyclone and SiC candle filters. The alkali emission from two different coal-sorbent combustions were determined. In the combustion of Pittsburgh Sewickley seam coal and Tymochtee dolomite at average bed temperatures of 900--925{degree}C, the alkali vapor concentration (Na + K) was measured by an Ames real-time, on-line alkali analyzer to be >50 ppbW in the PFBC flue gas. In the combustion of Beulah lignite of North Dakota and Tymochtee dolomite at average bed temperatures of 850--875{degree}C, the average sodium vapor concentration in the PFBC flue gas was measured to be 1.42, 1.51, and 1.31 ppmW by a newly developed analytical alkali sorber beds of activated bauxite (two beds) and diatomaceous earth, respectively. Based on these measurements, the average sodium vapor concentration of 1.3-1.5 ppmW in the PFBC flue gas of Beulah lignite is more than 1.5 orders of magnitude greater than the currently suggested alkali specification limit (0.024 ppm) for an industrial gas turbine. 15 refs., 7 figs., 2 tabs.

21976 **(DOE/PC/79863—T11) Model analysis of sulfur reduction technology and sulfur emission limitations: Annual report, March 1--December 31, 1987.** Arey, D.; Dziegielewski, B.; Crenshaw, J.; Parker, G.; Koscianski, J. (Southern Illinois Univ., Carbondale (USA)). Mar 1988. Contract FC22-87PC79863. 28p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008374/JAW.

The Coal Technology Laboratory Coal Supply and Transportation Model (CTL/CSTM) is being used to forecast the impact of the application of regulations (and potential regulations) concern-

ing the emission of SO_2 into the atmosphere on US coal production and distribution. Options for coal-burning utilities and industries to reduce SO_2 emissions include: switching to lower-sulfur coal, coal preparation, and application of combustion and/or flue-gas cleanup technologies. CTL/CSTM is a computer simulation of the US coal market. Input data which may be independently manipulated include: demand for coal by utilities and industry, resources for production of coal of various types in various coal-producing regions, the cost of transporting coal by barge or train from origin to destination, the cost of switching to lower-sulfur coal, the cost of coal preparation, and the cost of combustion and flue-gas cleanup technologies. Outputs are the amounts, quality, and prices of coal expected to be produced in various regions of the country, the total cost of using coal to meet energy demands, including SO_2 emission control, and the amount of SO_2 emitted into the atmosphere. 7 refs., 1 fig., 9 tabs.

21977 **(DOE/PC/88874—T2) Theoretical approach for enhanced mass transfer effects in-duct flue gas desulfurization processes: Quarterly report No. 2, October 1, 1988--December 31, 1988.** (Acurex Corp., Research Triangle Park, NC (USA). Environmental Systems Div.). 13 Jan 1989. Contract AC22-88PC88874. 68p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008701/JAW.

During this reporting period, October 1, 1988 through December 31, 1988, experimental works of Task 2, mass transfer testing have been initiated. The stirred tank reactor for Task 2.1 has been modified to maximize the gas film mass transfer coefficient in an attempt to eliminate gas film resistance. The construction of the reactor will be completed and experimental testing will be started in the first quarter of 1989. The apparatus used for Task 2.2, the differential reactor, has also been modified during this reporting period. This modified differential reactor can be used to measure gas/solid reaction at contact time as short as 10 s. Preliminary results showed that approximately 16 percent conversion of lime was obtained with a contact time of 30 s. More experiments will be performed in the next three months to establish baseline performance. Construction of the flow reactor for Task 2.3 also has been completed during this reporting period. Preliminary results showed that approximately 10 percent lime conversion was obtained with 2 s residence time. More tests are planned to measure the gas/solid reaction at reaction times less than 2 s. The equations describing the simultaneous absorption-dissolution-crystallization process for Task 3.1, computer modeling of slurry injection, have been developed. The next step is to write a computer program using numerical methods to solve the equations. Experiments related to Task 4.3, production of lime/flyash absorbent, were also initiated during this reporting period to investigate the chemistry of the flyash-lime reaction using bench-scale equipment. The results will be used to determine the effects of flyash type, the presence of $CaSO_3$, the slurry temperature, and the effects of additives to the slurry. 18 refs., 27 figs., 3 tabs.

21978 **(KFK-PEF—47) Denitrification and desulfurization of flue gas by corona discharge.** Scheuermann, A.; Bloss, W.H. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Physikalische Elektronik). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre; Stuttgart Univ. (Germany, F.R.). Inst. fuer Physikalische Elektronik). Nov 1988. 56p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88757386/JAW.

The effect of corona discharges and silent gas discharges was examined by laboratory experiments using synthetic gas mixtures. Experiments with steady corona discharges in wire-cylinder-arrangements showed, that the concentrations of NO, NO/sub x/ and SO/sub 2/ can be reduced. Degrees of conversion strongly depend on gas composition, especially on the components H/sub 2/ O and NH/sub 3/. In general the energy efficiency of corona discharges is relatively small. The energy efficiency concerning the conversion of NO and NO/sub x/ increases by at least a factor of two when experiments with the silent discharge, which is used for the production of ozone with high efficiency, are compared to experiments with corona discharges, whereas the question concerning SO/sub 2/ is not yet solved. In these experiments CO was detected, formed by dissociation of CO/sub 2/, at substantially higher concentrations when using the silent discharge compared to results with the corona discharge. (orig./RB) With 26 figs., 13 refs.

21979 **(KFK-PEF—48) Development of a new agglomerator for the elimination of flue gas aerosol.** Backhaus, A.; Conrads, M.; Wurz, D.; Zimmermann, M. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Technische Thermodynamik). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre; Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Technische Thermodynamik). Dec 1988. 87p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757387/JAW.

The aim of this investigation is the test of a droplet agglomerator in practice, which has a high agglomeration rate, low energy consumption and a good performance in service. The collection of aerosols on wash droplets and the agglomeration of wash droplets are more closely treated as steps of a wet scrubbing system with an integrated droplet agglomerator. The results of the experimental investigations concerning five different types of agglomerators are presented and discussed. Droplets with $d > 5$ μm are entirely caught and transformed into drops with a minimum diameter of 30 μm, on average into drops with a diameter of 150 μm. The pressure drop coefficients of one agglomeration stage run between 2 and 8.5. For tests of the whole unit plant measurements with aerosol loaden flue gas were carried out. Spray nozzles with a frequency medium drop diameter of 100 μm (L/G-ratio of 0.8) and pneumatic atomizing nozzles with a frequency medium drop diameter of 20 μm (L/G-ratio of 0.5) were used. First analysis resulted in aerosol elimination rates of 25-38% using spray nozzles and 78-84% using pneumatic atomizing nozzles. (orig./RB) With 43 figs., 25 refs.

21980 **(NP—9770319) Lignite coke coal as catalyst for denox and removal of SO2, vapour state heavy metals and particulates.** Marnet, C.; Kassebohm, B.; Asmuth, P. (Stadtwerke Duesseldorf A.G. (Germany, F.R.)). [1988]. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE89770319/JAW.

An effective, simple handling and efficient system for mainly medium and small sized power plants, district heating plants, garbage incinerators etc. up to 300 MW electric output could be developed. For the 80 to 90% decrease of the acidic components in the flue gas the 'Spray Drying System Duesseldorf' has been applied in the meantime for more than 25 units of different sizes and a total of more than 3 million cubicmeters. The combination of a lignite coke filter and catalyst as a multistage filter coupled with the spray drying system, filters the rest of solids, adsorbes (the rest of) the acidic components, the vaporous heavy metals, the carbon hydrates etc. After adding ammonia to the flue gas the coke coal then works as a catalyst for the NO/sub x/-reduction at temperatures of about 80 to 100/sup 0/C, that means without any expensive reheating, as known from the metal type catalysts. The lignite coke is an uncomplicated, inexpensive material, which will be burned as fuel after use. The coke consumption only depends on the amount of the acidic components in the flue gas (i.e. efficiency of the scrubber). The results measured up to now have shown that with lignite coke (1) the flue gas from a coal-fired boiler can be completely desulfurized, whereby SO/sub 2/ loadings of the coke of 10-15% are to be achieved, (2) with the flue gas remaining in the coke for a period of 15-20 seconds it is possible to achieve NO/sub x/ reductions of 80-90%, (3) the NO/sub x/ content in the clean gas varies between 150 and 250 mg/m/sup 3/n.

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REFER ALSO TO CITATION(S) 21971, 21972, 23045, 23046

21981 **(CONF-890447—3) Distribution transformer performance when subjected to steep front impulses.** Burrage, L.M.; Shaw, J.H.; McConnell, B.W. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89002971/JAW.

From 11. IEEE/PES T&D meeting; New Orleans, LA, USA (2 Apr 1989).

The experimental method and the results of subjecting arrester protected pole type distribution transformers to the combined stresses caused by the conducted steep front impulse and rated 60 Hz voltages are described. Comparisons are drawn between these results and those of similar experiments on unenergized distribution transformers. Additional comparisons are made with low voltage impulse wave distribution results previously reported. It is concluded that: (1) tank mounted direct connected arresters provide a high degree of protection to these transformers; (2) tank mounted externally gapped or crossarm mounted arresters may not provide sufficient protection; (3) internal transformer insulation system failures caused by the steep front impulse do not necessarily result in immediate catastrophic failures of the transformers. 10 refs., 6 figs.

21982 **(CRIE—W-03) Advanced technology for underground power distribution system. Reduction of construction cost.** (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Sep 1987. 93p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757164/JAW.

The installation and construction costs of underground distribution system are 10 to 15 times higher than that of overhead one. Therefore, the cost reduction of underground distribution system becomes an important and pressing problem. Development of various technologies were studied in order to reduce the total cost to half civil engineerings, equipments and underground construction. The results of the study are as follows. Burying depth of the cables can be reduced to a shallow depth up to 30cm under sidewalk pavements. Economizing construction of man-hole structure was studied in order to reduce excavation. Heat pipe is applied to improve heat radiation from underground transformer and to reduce size of the transformer, hand-hole. Other various studies were carried out as follows: an undergruound radar technique for searching buried pipes, utilization of the excavated soil, limiting the short circuit current, a design method of new pole-mounted equipment for street amenity and townscape, the techniques in relation to the equipments, and a computer design program of underground distribution system. The goal of this research was almost achieved. (60 figs, 25 tabs, 17 refs)

21983 **(CRIE-T—87038) Hum noise from AC transmission lines (II). Random Walk model on space distribution.** Tanabe, Kazuo. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jul 1988. 35p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756826/JAW.

To evaluate the Hum noise generated from the AC transmission lines during the rain, the spatially statistic properties of Hum noise level were clarified by means of Random Walk theory. On the lateral profile rectangular to the transmission line route, the Hum noise reaching the respective spot from the respective line is almost equal in pressure and different in phase. By substituting the probability density distribution of absolute value of sum of N vectors, which were equal in absolute value and independent in mutual phase and had a uniform probability density, for the probability density distribution of Hum noise pressure on all the spots and developing it with approximation as a Random Walk, formulas to determine the probability density distribution and cumulative distribution of Hum noise pressure and level were derived. The cumulative distribution obtained from the actually measured data of Hum noise directed rectangularly to the transmission line route coincided well with the typical distribution derived from the formula. As a result of studying the validity of average power value to evaluate the Hum noise level under the transmission lines, it entered a +-2dB range with the probability of 80%. (16 figs, 1 tab, 12 refs)

21984 **(CRIE-T—87061) Step-out prediction through on-line estimation of external system.** Taniguchi, Haruhito. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jul 1988. 39p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756830/JAW.

In order to allow to use effectively the on-line information and judge the situation using the terminal information in the emergency control of the electrical power supply system, the logic to estimate the external system from the generator terminal information using two time points data during generator swing has been developed. Using this estimated external system, two methods to predict the generator step-out were developed. One is the application of the equal area criterion and another is the predictive simulation method using the initial state variables during generator swing. The developed logic and methods were verified by simulation of fundamental one machine to infinite bus system and also other systems including the nonlinear load and the midway generator. As an example, fllowing results were obtained in the case of the system including the midway generator; the predictive function to judge the system stability was very high, quantative index for the system stability was obtained, step-out judgment on the n-wave was accurate. Consequently, this developed logic on step-out prediction was confirmed its effectiveness. (17 figs, 2 tabs)

21985 **(CRIE-T—87062) Current required for preventing wet snow accretion on transmission lines.** Kawanishi, Seiichi; Sakamoto, Yukichi; Shimada, Yoshihiro; Josho, Misao; Kawaguchi, Mamoru; Mizushima, Kazuo. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jul 1988. 24p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756831/JAW.

On the snow accretion due to capillarity which occures by wet snow at a temperature of around 1°C caused by the extratropical cyclone, artificial snow accretion tests using wind tunnel facility were performed. Electric current required for preventing wet snow accretion on wires were presented based on an analysis of heat balance. Relationship between melting current of wet snow accretion and its melting ratio were derived from the calculated results using the formula of the current required for melting accreted snow on wires. As a result, it was shown numerically that a live current on the line prior to the initiation of snow accretion is effective to prevent wet snow accretion. When liquid water content of accreted snow arrived over about 30%, snow accreted on wires were spontaneously dropped. The equation to define the current required for preventing wet snow accretion are derived on the basis of heat balance analysis of accreted snow. For preventing wet snow damages on power lines, in the case of wet snow with liquid water contents of 10% and the snowintensity of 5cm/h under the wind velocity of 5-10m/s and a temperature of around 1°C, it is required that current exceeding 30-50% of rated permissble current should be applied prior to the beginning of wet snow sleeve developed. (8 figs, 1 tab, 7 refs)

21986 **(CRIE-T—87085) Reduction of switching overvoltage on transmission lines.** Matsubara, Hiroharu; Ono, Takao; Motoyama, Hideki. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Aug 1988. 41p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756832/JAW.

Consequently upon the recent increase in performance of the zinc oxide type arresters and as in a rationalization series in insulation of the power transmission/transformation facilities, the reduction effect in switching surge by the application of arresters was studied for the objective of 500 and 275kV lines serving as main ones. The resistance charging method is applied to the 500kV line, therefore its lengthening in transmission line causes the enlarging in overvoltage multiple. By the installation of high performance arresters, the maximum overvoltage multiple can be reduced from 1.65 to 1.60pu and from 2.25 to 1.85 pu on the 100 and 200km, respectively, transmission lines. As for the arresters on the 275kV line route, the maximum overvoltage multiple of 2.20pu generates on its center line of route. If the high speed three-phase reclosing method is applied thereto, that of 2.60pu so does. Furthermore as a help to the rational insulation design, a calculation programming of switching surge accident factor being completed, the accident factor of 200km long 500kV transmission line was analyzed. (29 figs, 6 tabs, 2 refs)

21987 **(CRIE-W—87011) Development of over-current coordination support expert system for low voltage spot-network system.** Goda, Yutaka; Sunabe, Kinya; Adachi, Kazuo. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jan 1988. 32p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756837/JAW.

Over-current coordination support expert system was developed to select the protecting device in the low voltage spot-network system which is recently employed in many multistory buildings. The object was 22kV incoming voltage and 2-4 incoming circuits. When a user inputs the system conditions such as incoming circuit number and voltage, necessary data to infer were automatically calculated and the result is inferred by comparing these with the system characteristic data and by using the knowledge base as to the over-current coordination support. When the over-current coordination support for the switchgear protection was examined on a practical device having 3 incoming circuits, it was verified that the knowledge base of this system described appropriately the rule concerning the over-current coordination support of the device. It is possible to select the protecting device without the manual and to check the coordination support for a short time and further to lower the personal misoperation. Moreover, the optimal and economical design becomes possible when the switchgear protecting device for a incoming circuit is designed. (13 figs, 3 tabs, 17 refs)

21988 **(CRIE-W—87027) Development of a compensation device for momentary voltage dip of distribution lines.** Ito, Hideo; Izumi, Kunikazu, Sekiguchi, Koichi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Apr 1988. 30p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756840/JAW.

Momentary voltage dip of distribution lines can influence the operating characteristics of electronic devices, so that a compensation device for momentary voltage dip was developed for computer systems and video tape recorders. Limits of operating conditions for the surveyed devices were measured to get the operating characteristics. On the basis of these measurements, the specification was determined to the 1kVA capacity so that the device can operate within 40ms after the start of voltage variation and maintain 80V or more at the voltage dip down to 60%. When the momentary voltage dip occurrs, the release of rated voltage tap and the transformer tap closing corresponding to the difference are operated by determining the difference between the voltage integration every 1/4 frequency and the standard value proportionate to the rated voltage. When the voltage is restored, the transformer tap is returned to the rated voltage tap through the similar procedure. The responce time was 0.01 to 0.03 second as the aim in the voltage dip loading test of the trial device. No misfunction could be found in the practical load. This device has features of small size, light weight, low noise, low loss and low price. (15 figs, 5 tabs, 3 refs)

21989 **(CRIE-W—87028) Lightning surge operating duty and protection effect on 66kV transmission line surge arresters.** Izumi, Kunikazu; Taniguchi, Tsuyoshi; Ito, Hideo; Takanashi, Mitsugu. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Apr 1988. 46p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756841/JAW.

The lightning surge duties of gapless transmission line arresters and the lightning protection effects on a 66kV double-circuit overhead transmission line were studied when the surge arresters were applied to all phases of one circuit. The arrerster current amplitudes are about 4% of the stroke currents and the waveform is 4/10 micro second and 85% and 2/13 micro second respectively in case of the shield failure. The minimum stroke current amplitude occurring flashovers is about 45kA in both cases of the lightning strokes to the tower top and the shield failures. The lowest stroke current amplitude occurring flashover at the striken phase is about 95kA in case of the shield failures. The simultaneous flashover rate on the double-circuit is estimated about 0.01 per 100km per year when the arrester is aplied on one circuit. The lightning accident can be almost prevented in the transmission line shielded sufficiently by the overhead ground wire when the arrester is applied on one circuit. (26 figs, 9 tabs, 11 refs)

21990 **(CRIE-Y—88010) Process model for assessing customers' response to time-of-use rates for the heavy electrical machinery industry (1). Case study.** Asano, Hiroshi; Sagai, Shigeo. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Aug 1988. 40p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756834/JAW.

The customers' response to the structure of electricity rates for the industrial electricity demand has been analyzed by use of a customers' model based on the manufacturing process. A process model for a scheduling type production was developed and the customers' response to the structure of electricity rates in the heavy electrical machinery industry was evaluated. In obtaining a solution, an approximate value was obtained through the quasi-optimization method which is a successive improvement of the initial answer, because it is impossible to obtain a rigorous answer in the usual time. Sensitivity analyses were carried out varying the peak/off-peak energy charge ratio in the range of 1 to 10, and it was shown that 20 to 25% of the electricity demand in the process of electrical testing for large-scale turbine generators at the works may be shifted from the peak time zone to the off-peak time zone. The customers' load pattern varies significantly in the peak/off-peak charge ratio between 1 to 2, in the charge ratio of 3 and above the effect of time-of-use rates was not found. (6 figs, 8 tabs, 12 refs)

21991 **(EPRI-EL—6277) AC losses in the new high-temperature superconductors: Final report.** Clem, J.R. (Electric Power Research Inst., Palo Alto, CA (USA); Iowa State Coll., Ames (USA). Dept. of Physics). Mar 1989. 55p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report describes work concerning the properties of the high- temperature oxide superconductors. This work falls into four general areas: ac losses in the superconducting state, ac losses in the normal state, anisotropy in the superconducting state, and monitoring developments in high-temperature superconductivity. General theoretical expressions for the ac losses of bulk samples of the new high-temperature superconductors are derived, starting with a simple model for the granularity, which is known to play a critical role. First, the loss per unit area of planar semi-infinite specimens is calculated. Then, to facilitate future comparisons with experiment, the loss per unit volume of solid and hollow cylindrical bulk samples is calculated. The ac losses in the superconducting state are shown to depend in general upon both the intergranular critical-current density J/sub cJ/ and the intragranular critical-current density J/sub cg/. The normal-state ac losses of the high-temperature superconductors are calculated. It is shown that, because the ac losses of bare superconducting material in its normal state are unusually high, it is important that the high-temperature superconductors be capable of being bonded electrically and mechanically to high-conductivity metallic substrates. The high-temperature superconductors are known to be highly anisotropic. The influence of this anisotropy upon the magnetic properties of the high-T/sub c/ superconductors is considered using the London approach. Particular attention is given to that unusual way that magnetic field penetrates into anisotropic superconductors. Possible structures of the flux-line lattices are discussed for arbitrary orientation of vortices with respect to the crystal. An extensive preprint data base, has been developed for monitoring developments in high-temperature superconductivity. 57 refs., 3 figs.

21992 **(IEIE—8801) 1988 joint convention record of institutes of electrical and information engineers, Japan (part 1).** (Institute of Electrical and Information Engineers (Japan)). 5 Sep 1988. 187p. (In Japanese). (CONF-8810337—Pt.1). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW.

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

This record consists of papers for joint convention of institutes of electrical and information engineers which was held in October 1988 in Niigata. Subjects of this convention are: recent trend of capacitors for electric power, superconducting rotation machines and their material development, distribution systems and information processing, gigantic artificial lightening and its application, automation of visual inspection, electric power transfer technology in

the 21th century, and AI application to production facilities. Five to seven papers are read on each subject. In the end of this record, five papers on computer architecture are inserted from Science Council of Japan. (234 figs, 55 tabs, 165 refs, 5 photos)

21993 (IEIE—8801, pp 5-8) **Recent trend of oil impregnated capacitor (self healing type).** Shioda, Kohei; Wada, Eiichi; Fukai, Masayasu. (Matsushita Electric Industrial Co. Ltd., Toyama, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

This paper describes the self healing type high pressure capacitor which is the newest type in oil impregnated capacitors. The self healing type oil impregnated capacitor has a structure holding a sheet of polypropylene film derivative between two sheets of double side metalized paper and this paper supports electrodes. Features of this capacitor are self healing, good impregnation, and built-in pressure sensing type protector. Performance of this capacitor depends on the impregnating agent and electrode. On the other hand, electric characteristic, dielectric characteristic, life, and safety of this capacitor are also examined. As a result, self healing type oil impregnated capacitors are suitable for capacitors of low-loss and high potential gradient. The self healing oil impregnated capacitor is supposed to play an important role for miniaturization, weight reduction, and resource saving. (10 figs, 1 tab)

21994 (IEIE—8801, pp 9-12) **Recent trend of oil impregnated capacitor (NH type).** Yamanaka, Keiji. (Nichikon Capacitor Ltd., Kyoto, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

This paper describes the NH type oil impregnated capacitor which occupies a major part of capacitors for electrical power. The main feature of the NH type oil impregnated capacitor is its miniaturization. Therefore, high potential gradient and low-loss were required. The shape of the dielectric was changed to film, and new impregnated agent and bent edge foil electrodes were adopted. Improvement of safety is one of the important subjects and various protectors have been developed. Comparing the feature of recent oil impregnated capacitor (NH type) to that of paper-film type capacitor, the temperature dependence of capacity is somewhat large, the electrical loss is remarkably low, and corona voltage is highly improved. Various failure detectors have been developed as protectors. (9 figs, 2 tabs, 8 refs)

21995 (IEIE—8801, pp 13-16) **Low pressure dry polypropylene capacitor for electrical power.** Matsui, Yoshisada; Maruoka, Keizo; Fujiwara, Takeo. (Shizuki Electric Co. Inc. Nishinomiya, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

Low pressure dry polypropylene capacitors are recently used in electrical power systems. This paper describes the recent tendency of dry capacitors and also outlines 200V low pressure dry phase advance capacitors. Structure, rated voltage, dielectric life, and protection system are examined for dry capacitors as well as for low pressure phase advance capacitors which are dried by encapsulating air. From now, the dry capacitor is considered to be spread. The technical problems to be solved are as follows; corona discharge must be reduced, and dielectric strength, resistance against excess voltage or current, reliability to protection must be improved. Research for dielectrics and deposited metal and its manufacturing condition are considered important. (13 figs, 3 tabs, 3 refs)

21996 (IEIE—8801, pp 17-20) **Recent trend of dry capacitor in high pressure use.** Muraoka, Takashi. (Nisshin Electric Co. Ltd., Kyoto, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

Dry capacitors for electrical power have been used in low pressure, but because of urban development, use of such capacitor in high pressure is also demanded. This paper examines the trend of dry high pressure capacitors already developed and put into practice and also describes characteristics of gas insulated phase advance capacitors and molded capacitors. As for dielectrics of dry high pressure capacitors, NH type dielectric, MF type dielectric, and high pressure ceramic dielectric are examined and characteristics and structures of gas insulated and molded capacitors are also described. From these examination results, the use of high pressure dry capacitors the development of which is delayed is analyzed and the necessary condition for its development is discussed. (13 figs, 1 tab, 10 refs)

21997 (IEIE—8801, pp 21-24) **Recent trend of large capacity capacitor facility.** Ichiwara, Takeshi; Matsumoto, Yoshiaki; Nakayama, Seiji. (Nisshin Electric Co. Ltd., Kyoto Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

The development of capacitors in Japan that have the longest use in electric devices was studied. Capacitors were used in communication or series circuits; however, they began to be used in parallel circuits in 1930's. Now, capacitors of which capacitance is 20000 KVA have been developed after a long period of research and development. This type of capacitor is called large capacitance small size capacitor. Features of this capacitor are small installation space, safety, high reliability, and reduced maintenance. Other various types of capacitor have been developed and practically used considering reliability and space saving. On the other hand, considering social requirements, such as constant supply of high quality power, pursuit of total economy, harmony to community, new subjects must be studied and results must be reflected on new products. (5 figs, 4 photos, 4 refs)

21998 (IEIE—8801, pp 25-28) **Recent trend of higher harmonic filters and static var compensators.** Yoshida, Yoshinobu; Fukagawa, Hiromasa. (Fukuyama Univ., Fukuyama, Japan; Central Research Inst. of Electric Power Industry, Tokyo (Japan)). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

With the recent development of electric load facilities and systems, high quality electricity is required. Thus the use of higher harmonic filters and static var compensators (SVC) is extensive to improve the stability of electric power, and proper use and installation of such equipments are being studied. The capacitor operation research special committee researched the installation, operation, and the use of reactive capacitors in Japan. Results revealed that the quantity of the higher harmonic filters installed is 1440 MVA or 1.9% of the quantity of the phase modifying capacitors installed and the quantity of the SVCs installed is +- 1700 MVA. Capacitors improved to suppress voltage flicker clearly tend to increase; quantity, rather than capacitance, is growing. This demonstrates that improvement has been increasingly implemented in small-capacitance capacitors. (12 figs, 1 tab)

21999 (IEIE—8801, pp 53-56) **Automatic meter inspection by transmission over distribution line.** Miura, Naoto; Sato, Masao; Narita, Hiroshi; Takagi, Masatoshi. (The Tohoku Electric Power Co., Inc., Sendai, Japan; Osaki Electric Co. Ltd., Tokyo (Japan)). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

The purpose of development of automatic meter inspection is to deal with the problem of low efficiency in meter inspection work in overcrowded cities, depopulated suburban districts, snow, and distant areas. The use of distribution lines to transmit meter in-

formation has been studied and reported in this paper. In this method, signal attenuation in low voltage distribution lines and total reading rate reduction due to noise are problems; therefore, a signal wave detection method has been developed, and test results have been obtained. The results are summarized as follows: automatic meter inspection system configuration and noise characteristic; comparison method and addition and average method as waveform detection methods; ripple control, current answer back, and phase pulse method for communication control, signal attenuation analysis and moving average method as transmission characteristic analysis methods. (7 figs, 2 tabs, 2 photos)

22000 (IEIE—8801, pp 57-60) **Integrated power distribution automated system and multi-purpose utilization of its transmission path.** Matsumoto, Tsubasa. (The Kansai Electric Power Co. Inc., Osaka, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

This paper outlines the implementation of an integrated power distribution automated system in Kansai Electric Power Co., Inc. When installing this system, the company has made technical development and verification effort in order to utilize its transmission path having a broad extension not only for the remote control of switches, but also for other various purposes, including remote meter inspection, load control, and information transmission. The subjects covered are as follows: (1) The integrated power distribution automated system is outlined. (2) A model system designed to tests the multi-purpose use of the transmission path and the experiments conducted are outlined. (3) Various problems concerning the multi-purpose use of the transmission path are discussed, focusing on the results of comparison experiments on optical fiber cables, coaxial cables, and pair cables as well as the evaluation of the results. (4) Future plans for experiments and problems yet to be solved are summarized. (9 figs)

22001 (IEIE—8801, pp 61-64) **Integrated power distribution information system.** Yukawa, Yoshimitsu. (The Kansai Electric Power Co. Inc., Osaka, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

This paper outlines the integrated power distribution information system which Kansai Electric Power Co., Inc. has been developing as part of the company's new computerization project and which started operation in August, 1987 at all the company's branches. This system holds a variety of data occurring in the company's everyday jobs, creates information for decision-making on job and equipment quality maintenance and improvement from the stored data, and presents the resulting information online in graphs and other readable forms. The subjects covered are as follows: (1) The purpose of the system; (2) background of system development; (3) basic system configuration as well as fixed-format information creation system and variable-format information creation system; (4) features of the system; (5) effect of system implementation; (5) review of system development processes. (7 figs, 2 tabs)

22002 (IEIE—8801, pp 65-68) **Power distribution automated system.** Hirata, Yasushi. (The Chugoku Electric Power Co. Inc., Hiroshima, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

This paper outlines the power distribution online design system which began to operate at all establishments of Chugoku Electric Power Co., Inc. in September, 1987 and which is intended to shorten the period from the time a customer requests for the use of electric power to the time construction for power distribution to the customer is completed. The subjects covered are as follows: (1) The functions of the system are compared with those of the previous system which was used for the eight years beginning with February, 1970. (2) The hardware configuration of the online design system is outlined. (3) Design processing flow is explained. (4) The development of tools for terminals which help system operation is discussed. (4) The system is evaluated; the effect of system implementation and problems to be solved are discussed. (7 figs, 2 tabs)

22003 (IEIE—8801, pp 69-72) **Power distribution facilities and mapping system.** Nakura, Shoichi; Nakanishi, Yoshifumi; Endo, Koichi; Masumoto, Takehito. (The Tokyo Electric Power Co., Inc., Tokyo,, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

This paper outlines the mapping system which Tokyo Electric Power Co., Inc. is developing in order to take advantage of facility management drawings. One of the features of this system is that a great cost reduction has been achieved because automatic drawing reading and automatic recognition allowing quick initial data entry are adopted instead of labor-consuming digitizing data entry. A pilot system already began to operate in October, 1987 at a branch belonging to the Kanagawa Regional Office. The subjects covered are as follows: (1) Outline of the system; (2) features of the system, including initial data entry, data structure, and correction method; (3) future outlook -- the development of a power distribution construction design system and a reference drawing application system using an already created database is outlined. (5 figs, 2 tabs)

22004 (IEIE—8801, pp 73-76) **Development of power distribution audiovisual instruction system.** Ota, Yoshihiko. (Chubu Electric Power Co., Inc., Nagoya,, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

This paper outlines the CAI system for power distribution work instructions which Chubu Electric Power Co., Inc. developed and which uses Mitsubishi Electric Corp.'s personal computers Multi-16s. The subjects covered are as follows: (1) Background of development; (2) utilization of the system; (3) outline of the hardware -- devices composing the CAI system and their features are outlined; (4) outline of the software -- software configuration, teaching materials and their characteristics, software processing flow, and software features are outlined; (5) development framework and development period; (6) the present utilization of the system and future outlook. (5 figs)

22005 (IEIE—8801, pp 77-80) **Infrared sensors and image processing for power distribution facility diagnosis.** Yamashita, Takahiro; Mochizuki, Toshiyuki; Yasuda, Sho; Soma, Ken'ichiro. (The Tokyo Electric Power Co. Inc., Tokyo, Japan; NEC Corp. Tokyo (Japan); Hitachi Cable Ltd., Tokyo (Japan)). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

This paper describes diagnostic instruments for determining deterioration of electric power distlribution equipment, which Tokyo Electric Power Co., Inc., NEC Corp., and Hitachi Cable, Ltd. are developing jointly and which uses infrared sensors. This equipment utilizes the phenomenon that electric power facilities dissipate heat when deteriorated and diagnoses power facilities without need for stopping power to the facilities, work on poles, or contact to points being diagnosed. The description in the paper is divided into two parts. (1) The relationship between deterioration of power distribution equipment and the surface temperature is discussed. To investigate the relationship between insulator deterioration and temperature rise, experiments were conducted for the influence of ambient temperature, humidity, and wind as well as the relationship between joint deterioration and temperature rise; also, the results of the experiments are discussed. (2) The infrared imaging apparatus is discussed, focusing on the problem of sunlight elimination and the structure of the test-fabricated apparatus. (5 figs, 4 refs)

22006 **Monitoring load control at the feeder level using high speed monitoring equipment.** Reed, J.H.; Nelson, W.R.; Wetherington, G.R.; Broadway, E.R. (Oak Ridge National Lab., Oak Ridge, TN (US)). *IEEE Transactions on Power Delivery;* **4**: No. 1, 694-703(Jan 1989).

Traditional techniques for monitoring load control often have proven ineffective or costly. This paper describes the use of a high-speed data acquisition system (50 samples a second) to monitor load control. The system has proven extremely effective in evaluating the impact of load control. A methodology for detecting appliance starts within the high speed data is described and given a preliminary test. This high speed monitoring technology gives promise of being relatively inexpensive, of being highly reliable, and of providing real time information which can be used by power system operators to make decisions about load control actions.

22007 **Impact of automation on the reliability of the Athens Utilities Board's distribution system.** Lawler, J.S.; Lai, J.S.; Monteen, L.D.; Rizy, D.T. (Dept. of Electrical and Computer Engineering, Univ. of Tennessee, Knoxville, TN (US); Athens Utilities Board, Athens, TN (US); Power Systems Technology Program, Energy Div., Oak Ridge National Lab., Oak Ridge, TN (US)). *IEEE Transactions on Power Delivery;* **4**: No. 1, 770-778(Jan 1989).

In this paper the authors discuss the reliability effects of distribution automation on the Athens Utilities Board (AUB) in Athens, Tennessee. This investigation is part of the Athens Automation and Control Experiments sponsored by the U.S. Department of Energy, Office of Energy Storage and Distribution, Electric Energy Systems Program. In this experiment, distribution feeder equipment on twelve feeders connected to three substations is being remotely controlled from a central dispatch center. A supervisory control and data acquisition system provides substation and feeder monitoring and remote control of feeder circuit breakers, power reclosers, and load break switches. An analytical study is presented to show the improvement in conventional distribution system reliability indices that are achieved at AUB as a function of the penetration of automation equipment. The value of automation predicted by the study is highly sensitive to the historical outage data used in the analysis and to the economic worth of reliability assigned by the utility. Eight case studies are described, from actual AUB operations, where the automation system resulted in significant cost savings and reliability benefits that are not captured by conventional reliability indices. Other utilities should expect similar benefits, which will be difficult to quantify analytically but, which add to the value of and justification for distribution automation.

22008 **Some applications of phasor measurements to adaptive protection.** Thorp, J.S.; Phadke, A.G.; Horowitz, S.H.; Begovic, M.M. (Cornell Univ., Ithaca, NY (US)). *IEEE Transactions on Power Systems;* **3**: No. 2, 791-798(May 1988).

The application of microprocessor based phasor measurements to new adaptive protection schemes is presented. The concepts of digital adaptive protection in which relay characteristics are modified in response to external signals and conditions in the system are examined. The importance of real-time phasor measurements in adaptive protection systems is illustrated by two examples. The first involves obtaining synchronizing information about phasor measurements too be used in a new type of current differential protection for a multiterminal line. by estimating the reference angles for the phasor measurements the effect of synchronized sampling can be obtained without the expense of synchronizing equipment. The second use of phasor measurements in adaptive protection is the adaptive setting of out-of-step blocking and tripping. Traditional problems of setting out-of-step blocking and tripping are caused because the settings are, of necessity, compromises based on off-line studies. By reacting to real-time phasor measurements from selected buses in interconnection it is shown that improved out-of-step blocking and tripping is possible.

22009 **Towards a computationally feasible on-line voltage instability index.** Tiranuchit, A.; Ewerbring, L.M.; Duryea, R.A.; Thomas, R.J.; Luk, F.T. (Cornell Univ., School of Electrical Engineering, Ithaca, NY (US)). *IEEE Transactions on Power Systems;* **3**: No. 2, 669-675(May 1988).

The power system voltage collapse problem is a complex problem and has not been thoroughly understood. Several researchers have proposed characterizing a collapse using the singularity of the Jacobian of the network descriptor load-flow equations. Previously the authors proposed using the minimum singular value of the Jacobian as a security index for monitoring how closely a power system is operating to a voltage instability. However, a Singular Value Decomposition (SVD) computation is a interactive process with the number of arithmetic operations proportional to the cubic power of the matrix size. Thus, computing an SVD on traditional serial computers will become unacceptably slow as the system size grows large. In this paper, the authors discuss state-of-the-art SVD computation schemes using large arrays of parallel processors that improve a computation speed linearly and quadratically. They also show a comparison between the computation speed and the number of arithmetic units required for various parallel architecture schemes as well as for the traditional serial computer.

22010 **Observability analysis and bad data processing for state estimation using hachtel's augmented matrix method.** Wu, F.F.; Liu, W.H.E.; Holton, L.; Gjelsvk, A.; Aam, S. (Univ. of California, Berkeley, CA (US)). *IEEE Transactions on Power Systems;* **3**: No. 2, 604-611(May 1988).

The triangular-factorization-based observability analysis and the normalized-residual-based data processing are extended to state estimation using Hachtel's augmented matrix method. The Hachtel's method is numerically robust, computationally efficient, and reasonable in extra storage requirement. In this paper it is shown that the observability analysis can be carried out in the process of triangular factorization of the augmented coefficient matrix used in the Hachtel's method. Moreover, the normalized residuals are shown to be obtainable using the sparse inverse of this augmented matrix. The algorithms have been successfully incorporated in the state estimation program developed at Norwegian State Power Board (Statkraft). Test results on the IEEE 14 bus system and a 99-bus system consisting of the main grid of southern Norway are presented. The Hachtel's approach to state estimation provides an attractive alternative to the standard normal equations approach.

22011 **High temperature superconductivity.** Laquer, H.L. (CryoPower, Inc., Los Alamos, NM (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889412.

The authors first review some of the history of superconductivity, summarize the properties and physics of superconductors as compared to ordinary conductors, and look at existing or proposed applications of "classical" high field superconductors in magnets and power systems. They then discuss the characteristics of the new high temperature ceramic oxide materials, point out their differences from previously used conductors, reasons for wanting to use them, and speculate on possible scenarios and impediments to their engineering deployment. They also briefly touch on mechanical and electrical properties, anisotropy, critical current densities and the related topic of superconductor stability.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 21789, 22072, 22082, 22225, 22300, 23696

22012 **(INIS-mf—11926) Availability data of the power supply to nuclear power plants.** (Deutsche Verbundgesellschaft e.V., Heidelberg (Germany, F.R.)). Nov 1980. 22p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757372/JAW.

The report explains collection and evaluation of data on nonavailability of the mains supply system of nuclear power plant due to operational disturbance. These data must form part of the documentation to be presented in proof of the reliability of a reactor's safety system power supply, in accordance with KTA rule 3701.1, 'Principal requirements to be met by the power supply to the safety

system of nuclear power plant', (amendment 6/78). For determination of disturbance-induced non-availability, failure rates and LOSP times for the units under review have to be known. These data are presented for 380 kV units of a power supply system, drawn from documentation of several years of operation of the 380 kV grids of all utilities under review. For 110 kV units, data can be found in the literature.

22013 (Juel-Conf—62, pp 51-65) **Amount of solid waste emanating from nuclear power plant decommissioning as a function of maximum permissible contamination.** Lukacs, G.; Petrasch, P. (Nuklear-Ingenieur Service G.m.b.H., Hanau (Germany, F.R.)). Jul 1988. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW. (CONF-8711296—).

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

The paper first explains the calculation of the materials and radioactivity inventory of a nuclear power plant at the end of serviceable life; and then the effects of a change of maximum permissible activity levels. The authors use results of investigations made for the purpose of proving the feasibility of decommissioning nuclear power plant, and for assessing the waste management requirements. The computer code STILLKO 2 has been developed within the framework of said investigations.

22014 (NUREG—0020-Vol.13-No.2) **Licensed operating reactors status summary report data as of January 31, 1989.** Schwartz, I. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Computer and Telecommunications Services). Mar 1989. 497p. NTIS, PC A21/MF A01 - GPO - OSTI. Order Number TI89008222/JAW.

The US Nuclear Regulatory Commission's monthly LICENSED OPERATING REACTORS Status Summary Report provides data on the operation of nuclear units as timely and accurately as possible. This report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices, IE Headquarters and the Utilities; and the third section is an appendix for miscellaneous information, such as spent fuel storage capability, reactor years of experience, and non-power reactors in the United States.

22015 **An underground nuclear power station using self-regulating heat-pipe controlled reactors.** Hampel, V.E. (to Dept. of Energy). US Patent Application 7-194,772. 17 May 1988. 49p. Contract W-7405-ENG-48. DE89009666 NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009666/JAW.

A nuclear reactor for generating electricity is disposed underground at the bottom of a vertical hole that can be drilled using conventional drilling technology. The primary coolant of the reactor core is the working fluid in a plurality of thermodynamically coupled heat pipes emplaced in the hole between the heat source at the bottom of the hole and heat exchange means near the surface of the earth. Additionally, the primary coolant (consisting of the working fluid in the heat pipes in the reactor core) moderates neutrons and regulates their reactivity, thus keeping the power of the reactor substantially constant. At the end of its useful life, the reactor core may be abandoned in place. Isolation from the atmosphere in case of accident or for abandonment is provided by the operation of explosive closures and mechanical valves emplaced along the hole. This invention combines technology developed and tested for small, highly efficient, space-based nuclear electric power plants with the technology of fast- acting closure mechanisms developed and used for underground testing of nuclear weapons. This invention provides a nuclear power installation which is safe from the worst conceivable reactor accident, namely, the explosion of a nuclear weapon near the ground surface of a nuclear power reactor. 5 figs.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 21783, 21786, 21791, 22033, 22035, 22075, 22101, 22104, 22112, 22134, 22149, 22150, 22155, 22208, 22209, 22220, 22222, 22224, 22226, 22227, 22230, 22234, 22235, 22236, 22237, 22252, 22835, 23902

22016 (CONF-8612174—3-Vugraphs) **Heavy-section steel technology program: An overview.** Pugh, C.E. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008623/JAW.

From Vessel integrity review group meeting; Oak Ridge, TN, USA (2 Dec 1986).

The major focus of the current irradiation work is on understanding the fracture characteristics of irradiated high-copper weld materials and stainless steel cladding. Testing in the Fifth and Sixth HSST Irradiation Series are underway and include two high-copper weld materials (CU = 0.25 and 0.30%). Both crack initiation and arrest-toughness properties are being investigated. The tests also include Charpy V-notch, tensile, and compact specimens, with the latter ranging in size up to 4TCS for the irradiated high-copper weld materials. The Seventh Irradiation Series is examining the effects of neutron exposure on the fracture properties of stainless steel cladding.

22017 (EPRI-NP—6230-M) **BWR/6 startup and transient tests at Grand Gulf Nuclear Station: Final report.** Bhandari, B.J.; Crouch, W.D.; Nir, I.; Peng, S.J.; Rao, D.; Sanjines, L.F.; Alesil, G.; Nourse, R.D. (Electric Power Research Inst., Palo Alto, CA (USA); Middle South Utilities/SERI, New Orleans, LA (USA); General Electric Co., San Jose, CA (USA). Nuclear Engineering Div.). Mar 1989. 69p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report documents the results of four plant tests performed during the Grand Gulf Nuclear Station Unit 1 startup test program. The report provides a source of first-of-a-kind BWR/6 data and an interpretation of the major data trends. The data may be applied in the qualification of reactor simulation computer codes. The transient data were recorded through the use of a General Electric Transient Analysis Recording System (GETARS). The detailed data trends are provided in Part I of the proprietary version of this report (2nd tier). Part II of the 2nd tier (proprietary) report entitled, "Reactor Design Data for Grand Gulf Nuclear Station Unit 1," provides the reactor design data which can be used for the construction of a computer model to simulate the transients reported herein. The actual data are available from Electric Power Research Institute. 5 refs., 1 fig., 11 tabs.

22018 (EPRI-NP—6241) **SIGTRAN: A kinetics linkage code for the Reactor Analysis Support Package (RASP): Final report.** McClure, J.A.; Gose, G.C. (Electric Power Research Inst., Palo Alto, CA (USA); EI International, Inc., Idaho Falls, ID (USA)). Mar 1989. 201p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Reactor Analysis Support Package (RASP) developed under EPRI sponsorship provides a verified and validated set of codes for use in reactor reload and safety analysis work. To accomplish this task, the RASP package contains a number of both core physics and thermal-hydraulics analysis programs whose diverse data requirements make data management an important task in the package. An integral part of the RASP concept is to make information flow among these codes as automated as feasible. For this purpose, RASP also contains linkage codes whose functions are to transcribe and modify information passing between the analysis codes. The SIGTRAN code is a member of the set of linkage codes in RASP which transcribes cross-section information from the reactor physics codes to transient analysis codes. The SIGTRAN code can be utilized for both PWR and BWR applications and will construct cross-section representations for the RETRAN-03, BNC, or ARROTTA analysis codes. 16 refs., 1 fig., 15 tabs.

22019 **(EPRI-NP—6273) Accuracy of ultrasonic flaw sizing techniques for reactor pressure vessels: Final report.** Willetts, A.J.; Ammirato, F.V.; Kietzman, E.K. (Electric Power Research Inst., Palo Alto, CA (USA); Jones (J.A.) Applied Research Co., Charlotte, NC (USA)). Mar 1989. 136p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

The accuracy of several ultrasonic flaw sizing techniques was measured using thick-walled mock-ups simulating typical reactor pressure vessel weld and clad configurations. The evaluated techniques were: backward-scattering tip-diffraction, time-of-flight diffraction (TOFD), dB-drop (with three different amplitude thresholds), and large-diameter focused probes. For the amplitude-based dB-drop technique, amplitude thresholds of 6 dB below peak, 50 percent DAC, and 20 percent DAC were used, and the effect of correcting for the spreading of the ultrasonic beam was also evaluated. The mock-ups contained intentional flaws representing three major classes of defects: cracks under the cladding, embedded defects in welds, and lack-of-fusion defects in nozzle-to-shell welds. Approximately 200 measurements were made. The results showed that for sizing near-surface and embedded defects in thick welds, TOFD and the backward-scattering tip-diffraction techniques were far more accurate than the amplitude-based techniques. Beam-spread corrections reduced the mean sizing errors for the 20 percent DAC sizing method, but made negligible reduction in the scatter of the data. Even after beam-spread corrections were made, the sizing errors of the amplitude-based method remained much greater than the tip-diffraction measurement error. For small-bore nozzles, focused probe measurements were substantially more accurate than unfocused probe measurements. 21 refs., 43 figs., 2 tabs.

22020 **(EPRI-NP—6278-M) Dresden Unit 2 hydrogen water chemistry: Chemical surveillance, oxide-film characterization, and recontamination during Cycle 10: Final report.** Ruiz, C.P.; Peterson, J.P.; Robinson, R.N.; Sundberg, L.L. (Electric Power Research Inst., Palo Alto, CA (USA); General Electric Co., San Jose, CA (USA)). Mar 1989. 25p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

This document provides an Executive Summary of work performed under Project RP1930-7, BWR Hydrogen Water Chemistry - Chemical Surveillance. It describes the work performed to monitor chemical and radiological performance at Commonwealth Edison's Dresden Nuclear Power Station Unit 2 during Cycle 10, its second full fuel cycle on Hydrogen Water Chemistry. It includes the results of water chemistry measurements, shutdown gamma scan/dose rate measurements, and the results of stainless steel oxide film characterization. This experience at Dresden-2 continues to demonstrate that a plant can operate on Hydrogen Water Chemistry with only minor impact on plant parameters, compared with the beneficial effect on intergranular stress corrosion cracking (IGSCC) mitigation of sensitized stainless steel components. 4 figs., 2 tabs.

22021 **(EPRI-NP—6291) Implications of possible reduction in radiation exposure limits: Final report.** Le Surf, J.E.; Cehn, J.I. (Electric Power Research Inst., Palo Alto, CA (USA); Le Surf (J.E.), Niagara Falls, ON (Canada)). Mar 1989. 62p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

The International Commission on Radiological Protection (ICRP) is currently reviewing the recommended limits on radiological exposure of nuclear workers. The findings of the review are expected to be issued in 1990 or 1991. There are indications that the revised recommendations will be for reduced limits. Based on new estimates of the exposures received by Japanese atomic bomb victims, the new recommended limit may be in the range 1 to 2.5 rem/year. Many countries will accept these recommendations unilaterally and some have already issued interim guidance statements recommending an annual exposure limit of 1.5 rem. Although the USA is not bound by these recommendations, it is unlikely that the NRC would continue with a set of limits higher than the rest of the world adopted. This report is preliminary examination of how such a change in worker exposure limit could be implemented in the US nuclear industry. No attempt is made to quantify either the impact or the benefits of such a change. The likely effect on the nuclear industry of a major decrease in exposure limits is discussed and the approaches taken by other countries with major nuclear programs to minimize radiation exposures is presented. Changes to the philosophy of radiation protection in this country that would allow accommodation of lower limits are suggested. Improvements to dose tracking and dose monitoring techniques are discussed. Methods for reducing existing radiation fields and for preventing future radiation field increases are briefly reviewed. 23 refs., 8 figs.

22022 **(JAERI-M—88-223) Study on the behavior of irradiated light water reactor fuel during out-of-pile annealing.** Yanagisawa, Kazuaki; Kanazawa, Hiroyuki; Uno, Hisao; Sasajima, Hideo. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Nov 1988. 46p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757260/JAW.

Using the pre-irradiated light water reactor fuel (burnup: 35 MWd/kgU) and the slightly irradiated NSRR fuel (burnup: 5.6 x 10/sup -6/ MWd/kgU), FP gas release rate up to the temperature of 2273 K was measured through out-of-pile annealing test. Results of this experiment were compared with those of ORNL annealing test (SFD/HI-test series) performed in USA. Obtained conclusions are: (1) Maximum release rate of Kr gas in light water reactor fuel was 6.4 % min/sup -1/ at temperature of 2273 K. This was in good agreement with ORNL data. FP gas release rate during annealing test was increased greatly with increasing fuel burnup and annealing temperature. (2) No FP was detected in NSRR slightly irradiated fuel up to the temperature of 1913 K.

22023 (Juel-Conf—62, pp 161-167) **Dismantling of large-size components and preparation for harmless recycling.** Neupert, D.; Kaemmerling, M.; Luck, W. (Transnuklear G.m.b.H., Hanau (Germany, F.R.)). Jul 1988. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW. (CONF-8711296—).

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

The tasks are illustrated by the example of a steam dryer unit from the Wuergassen reactor. The paper explains the required disassembly work for this large component prior to decontamination (thermal cutting by oxygen core tools) in a specific room.

22024 (Juel-Conf—62, pp 168-184) **Decontamination and other waste minimization methods applied in the Gundremmingen reactor station, unit A.** Stang, W.; Lasch, M. (Kernkraftwerke Gundremmingen Betriebsgesellschaft m.b.H. (Germany, F.R.)). Jul 1988. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW. (CONF-8711296—).

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

Unit A of the Gundremmingen nuclear power station was shut down in 1977 after an operational incident, and after receipt of the licence for decommissioning and limited dismantling, work started in 1983 with the clearing of the turbine building. A major task was management, disposal and recycling of the solid material and components removed from the controlled area. According to the atomic energy law, recycling of these materials has priority over disposal.

22025 **(NUREG/CR—4667-Vol.5) Environmentally assisted cracking in light water reactors: Semiannual report, April--September 1987: Volume 5.** Shack, W.J.; Kassner, T.F.; Maiya, P.S.; Park, J.Y.; Ruther, W.E. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Argonne National Lab., IL (USA)). Feb 1989. Contract W-31109-ENG-38. 66p. (ANL—88-32-Vol.5). NTIS, PC A04/MF A01 - GPO - OSTI. Order Number TI89008096/JAW.

This report summarizes work performed by Argonne National Laboratory on environmentally assisted cracking in light water reactors during the six months from April to September 1987. The stress corrosion cracking (SCC) behavior of Types 304, 316NG, and 347 stainless steel (SS) was investigated by means of

slow-strain-rate and fracture-mechanics crack-growth-rate tests in high-temperature water. The relative susceptibility of the solution-annealed Type 304 SS to crack initiation was determined in water with two dissolved-oxygen concentrations. The effect of dissolved copper and organic impurities on the SCC of sensitized Type 304 SS was also investigated. Fatigue tests are being conducted on Type 316NG SS in air at room temperature to provide baseline data for comparison with results that will be obtained in high-temperature water. The susceptibility of several heats of different grades of low-alloy steel to transgranular SCC was explored in slow-strain-rate tests at 289{degree}C, and the variation in the crack growth rates was attributed to differences in the sulfur content and sulfide inclusion distributions in the materials. 91 refs., 27 figs., 13 tabs.

22026 **(NUREG/CR—4792-Vol.1) Probability of failure in BWR reactor coolant piping: Volume 1, Summary report.** Holman, G.S.; Chou, C.K. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Lawrence Livermore National Lab., CA (USA)). Mar 1989. Contract W-7405-ENG-48. 132p. (UCID—20914-Vol.1). NTIS, PC A07/MF A01 - GPO - OSTI. Order Number TI89008911/JAW.

This report summarizes a probabilistic reliability evaluation of BWR reactor coolant piping performed for the US Nuclear Regulatory Commission (NRC) by the Lawrence Livermore National Laboratory (LLNL). In this evaluation, LLNL estimated the probability of a double-ended guillotine break (DEGB) in the main steam, feedwater, and recirculation loop piping of a representative Mark I BWR plant. Two causes of pipe break were considered: crack growth at welded joints, and the earthquake-induced failure of supports for piping and components. A probabilistic fracture mechanics model, including intergranular stress corrosion cracking (IGSCC) in Types 304 and 316NG stainless steels, was used to estimate the probability of crack-induced pipe break. The probability of pipe break indirectly caused by support failure was estimated by applying reliability techniques to supports for "heavy components" such as the reactor pressure vessel, as well as to conventional pipe supports such as spring hangers and snubbers. Our probabilistic fracture mechanics evaluation found that the probability of crack-induced DEGB in main steam, feedwater and, if IGSCC is not a factor, recirculation piping is very low. In ISGCC-susceptible Type 304SS piping, stress corrosion dominates the probability of DEGB due mainly to cracks that initiate during the first few years of plant life; replacing Type 304 piping with IGSCC-resistant Type 316NG lowers DEGB probabilities by several orders of magnitude. We also found that the probability of pipe break caused by seismically-induced support failure is low regardless of whether "heavy component" supports or conventional pipe supports are being considered. 23 refs., 34 figs., 16 tabs.

22027 **(NUREG/CR—4792-Vol.2) Probability of failure in BWR [Boiling Water Reactor] reactor coolant piping: Volume 2, Pipe failure induced by crack growth and failure of intermediate supports.** Lo, T.; Bumpus, S.E.; Chinn, D.J.; Mensing, R.W.; Holman, G.S. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Lawrence Livermore National Lab., CA (USA)). Mar 1989. Contract W-7405-ENG-48. 159p. (UCID—20914-Vol.2). NTIS, PC A08/MF A01 - GPO - OSTI. Order Number TI89008910/JAW.

The US Nuclear Regulatory Commission (NRC) contracted with the Lawrence Livermore National Laboratory (LLNL) to conduct a study to determine if the probability of occurrence of a double-ended guillotine break (DEGB) in the major coolant piping systems of nuclear power plants is large enough to warrant the current stringent design requirements of designing against the postulated effects of a DEGB. The study includes both the PWR (Pressurized Water Reactor) and the BWR (Boiling Water Reactor) plants in the United States. Following the study of PWR plants, a study of BWR reactor coolant piping was performed. The Brunswick Steam Electric Plant at Southport, North Carolina was selected as the pilot plant for the BWR evaluation. The probability of pipe failure in three major coolant pipings was assessed: the recirculation loops, the primary steam lines, and the main feedwater lines. In the case of recirculation loops, both the existing and a proposed replacement system were studied. A probabilistic fracture mechanics approach was used in this study to estimate the crack growth and to assess the crack stability in the piping systems throughout the lifetime of the plant. The effects of the failure of intermediate pipe supports were also examined. The results of the assessment indicated that the probability of occurrence of DEGB due to crack growth and instability is small if the problem of intergranular stress corrosion cracking (IGSCC) is resolved by the use of the replacement system. 33 refs., 41 figs., 32 tabs.

22028 **(NUREG/CR—5112) Evaluation of boiling water reactor water-level sensing line break and single failure: Generic Issue 101 boiling water reactor level redundancy - technical findings.** Bruske, S.J.; Collins, B.L.; Monnie, D.I.; Poloski, J.P.; Gregg, R.E. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution; EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1989. Contract AC07-76ID01570. 88p. (EGG—2536). NTIS, PC A05/MF A01 - GPO - OSTI. Order Number TI89008677/JAW.

This report presents an evaluation of the potential safety concerns identified in Generic Issue 101, related to Boiling Water Reactor (BWR) level sensing line breaks. For this review, failure combinations and transients were evaluated to assure that existing BWR plants could be safely shut down under postulated conditions of a break or leak in the instrument line of the reactor vessel level instrumentation plus an independent single failure in any protection system. The review evaluated all the designs currently employed in boiling water reactor plants. Part I of this report describes the methodology used to evaluate the various designs and provides technical findings. Part II presents the value/impact analysis performed to evaluate the various alternatives that were considered to improve plant response to a postulated water-level sensing line break and single failure.

22029 **(NUREG/CR—5115) A review of boiling water reactor water chemistry: Science, technology, and performance.** Fox, M.J. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Aptech Engineering Services, Inc., Sunnyvale, CA (USA)). Feb 1989. Contract W-31109-ENG-38. 69p. (ANL—88-42). NTIS, PC A04/MF A01 - GPO - OSTI. Order Number TI89008192/JAW.

Boiling water reactor (BWR) water chemistry (science, technology, and performance) has been reviewed with an emphasis on the relationships between BWR water quality and corrosion fuel performance, and radiation buildup. A comparison of Nuclear Regulatory Commission (NRC) Regulatory Guide 1.56, the Boiling Water Reactor Owners Group (BWROG) Water Chemistry Guidelines, and Plant Technical Specifications showed that the BWROG Guidelines are more stringent than the NRC Regulatory Guide, which is almost identical to Plant Technical Specifications. Plant performance with respect to BWR water chemistry has shown dramatic improvements in recent years. Up until 1979 BWRs experienced an average of 3.0 water chemistry incidents per reactor-year. Since 1979 the water chemistry technical specifications have been violated an average of only 0.2 times per reactor-year, with the most recent data from 1986-1987 showing only 0.05 violations per reactor-year. The data clearly demonstrate the industry-wide commitment to improving water quality in BWRs. In addition to improving water quality, domestic BWRs are beginning to switch to hydrogen water chemistry (HWC), a remedy for intergranular stress corrosion cracking. Three domestic BWRs are presently operating on HWC, and fourteen more have either performed HWC mini tests or are in various stages of HWC implementation. This report includes a detailed review of HWC science and technology as well as areas in which further research on BWR chemistry may be needed. 43 refs., 30 figs., 8 tabs.

22030 **(NUREG/CR—5292) Closeout of IE Bulletin 80-23: Failures of solenoid valves manufactured by Valcor Engineering Corporation.** Foley, W. J.; Dean, R.S.; Hennick, A. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Operational Events Assessment; Parameter, Inc., Elm Grove, WI (USA)). Feb 1989. 30p. (PARAMETER/IE—183). NTIS, PC A03/MF A01 - GPO - OSTI. Order Number TI89007967/JAW.

Documentation is provided in this report for the closeout of IE Bulletin 80-23 regarding failures in safety-related systems of nuclear power plants due to solenoid valves manufactured by the Valcor Engineering Corporation. Closeout is based on the implementation and verification of three actions by licensees of operating plants, or one action by holders of construction permits. Evaluation of utility responses and NRC/Region inspection reports indicates that the bulletin is closed out for all of the 120 facilities to which it was issued for action. Background information is supplied in the Introduction and Appendix A of this report.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 21750, 21752, 21778, 21783, 21786, 21841, 22016, 22018, 22019, 22021, 22022, 22025, 22026, 22027, 22030, 22052, 22063, 22064, 22065, 22068, 22075, 22085, 22101, 22106, 22112, 22134, 22140, 22142, 22144, 22145, 22146, 22147, 22148, 22151, 22152, 22153, 22154, 22155, 22158, 22160, 22163, 22208, 22209, 22211, 22217, 22220, 22227, 22230, 22233, 22235, 22236, 22237, 22299, 22815, 22835, 23902

22031 **(CEA-CONF—9693) Interpretation of two PWR vessel fluence benchmarks.** Vergnaud, T.; Nimal, J.C.; Totth, B.; Monnier, A.; Moreau, J.F.; Ait Abderrahim, A.; D'HONDT, P.; Fabry, A; Leeders, L.; Minsart, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques; Centre d'Etude de l'Energie Nucleaire, Mol (BE)). (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). 1988. 8p. (CONF-880906—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757338/JAW.

From 7. international conference on radiation shielding; Bournemouth, UK (12 Sep 1988).

Two calculation schemes are used to evaluate the fluence on PWR pressure vessels. In the first one, the neutron transport is studied by TRIPOLI-2 with the Monte Carlo method in 3D-geometries and has been applied to the REPLICA experiment at Winfrith. The second one is a simplified scheme, with the ANISN and MERCURE-4 codes, which has been used to interpret the VENUS benchmark at MOL and the measurements realized on the 900 Mwe-CPY french plants. Calculation results for activation detectors are compared with measurements and with other codes results.

22032 **(CEA-DAS—531) Growing importance of simulators for nuclear safety: from BUGEY 75 to SIPA 88.** Peltier, J.; Chapelier, F.; Depond, G.; Poizat, F. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete; Electricite de France, 93 - Saint-Denis (FR). Service de la Production Thermique; Electricite de France, 92 -Courbevoie (FR). Service Etudes et Projets Thermiques et Nucleaires). (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Dec 1988. 13p. (CONF-881014—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757339/JAW.

From International European Nuclear Society/American Nuclear Society meeting on thermal reactor safety; Avignon, France (2 Oct 1988).

The development of the French nuclear power plant network has given rise to the design and commissioning of a significant number of simulators. They can be divided into two categories: training simulators, design and operating simulators or analyzers. Full-scope or training simulators, initially designed for power plant operator training, play an increasingly important role in validation, adjustment and evaluation of accident and incident procedures from both the technical and formal aspects. Operating analysis simulators are additional tools in the armory of project engineers or safety analysis engineers. These simulators reap the benefits of advanced thermohydraulic design codes and are capable of effortless result analysis due to visualization of physical phenomena in real time.

22033 **(CONF-890373—1) Aging and service wear of air compressors and dryers in nuclear power plants.** Moyers, J.C. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008603/JAW.

From NPAR review group meeting; Rockville, MD, USA (21 Mar 1989).

Compressed air systems and their associated compressors and dryers as incorporated in LWR power plants usually are not classified as safety related systems and components because their continued operation is not required to bring the plant to a safe shutdown condition. However, control air is a vital requirement for maintaining stable plant operation and its loss often results in a reactor trip and, on occasion, the actuation of engineered safety feature systems. Concerns caused by repeated instances of failures in air systems resulted in the high-priority ranking of Generic Issue No. 43, "Reliability of Air Systems" by the NRC. In support of the Nuclear Plant Aging Research (NPAR) Program, the Oak Ridge National Laboratory is carrying out a Phase I aging assessment of air compressors and dryers used in LWR power plants. The objectives of this study include: (1) determination of the types and ratings of equipment utilized in typical plants; (2) identification of aging and service wear stressors imposed on the machines; (3) evaluation of operating experience with the machines; (4) comparison of user and manufacturer-recommended inspection, surveillance, and monitoring (ISM) methods; and (5) the identification of any improved ISM methods that might lead to longer, more reliable, service. 2 refs.

22034 **(CONF-8810155—42) Evaluation of selected samples from the TMI-2 core.** Liu, Y.Y.; Neimark, L.A.; Jackson, W.D. (Argonne National Lab., IL (USA)). Dec 1988. Contract W-31109-ENG-38. 18p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007265/JAW.

From 16. water reactor safety information meeting; Gaithersburg, MD, USA (24 Oct 1988).

Core-bore samples from the K9 and N12 locations in the TMI-2 core were examined for microstructural and microchemical features. The purpose of the examinations was twofold, first to determine core temperatures at known elevations in the core, and second to obtain insight into materials interactions that lead to core degradation. The temperature at the {approximately}50-cm elevation in the N12 location, a control rod position, was estimated to have been {approximately}960{degree}C and dropping sharply to less than 800{degree}C a few centimeters below. These temperatures were estimated based on the eutectic reaction between a control rod's Zircaloy guide tube and its stainless steel cladding, the β-phase transformation temperature in Zircaloy, and the melting temperature of the Ag-In-Cd control material. In the K9 location, local transient temperatures to {approximately}900{degree}C at the 37-cm elevation were estimated from the β-phase transformation in the Zircaloy cladding. Interactions of note were the guide tube/cladding eutectic interaction in the control rod, the apparent degradation of Zircaloy cladding by molten Cd and In, and the attack of stainless steel by Sn in a melt of Ag-In-Cd. 4 refs., 10 figs., 1 tab.

22035 **(EPRI-NP—5677) Below Regulatory Concern Owners Group: Radionuclide characterization of potential BRC waste types from nuclear power stations: Final report.** Robertson, D.E.; Thomas, C.W.; Hetzer, D.C.; Wynhoff, N.L.; Raney, P.J.; Forsythe, J.D.; Schmitt, J.S.; Buschbom, R.L.; Hara, K.T.; Strebin, R.S. (Electric Power Research Inst., Palo Alto, CA (USA); Pacific Northwest Lab., Richland, WA (USA)). Mar 1989. Contract AC06-76RL01830. 224p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

The objective of this study was to perform a detailed radiological characterization and statistical assessment of the measured radionuclide distributions for four candidate "below regulatory concern" (BRC) waste types from commercial nuclear power stations. These measurements and statistical evaluations will provide the bases for conducting detailed dose assessments associated with various disposal options for BRC wastes. The four waste types selected were dry active waste (DAW), oil, soil, and secondary side ion exchange resin. The measurement included gamma-spectrometric analyses of 558 total samples, including 102 DAW samples, 231 oil

samples, 142 soil samples, and 83 resin samples. Radionuclides usually detected during the gamma spectrometry included ^{60}Co, ^{137}Cs, ^{134}Cs, ^{54}Mn, and ^{58}Co. Frequently, ^{95}Zr, ^{95}Nb, ^{106}Ru, and ^{125}Sb were detected, especially in wastes from plants which had experienced a relatively high rate of fuel cladding failures. Selected aliquots of the gamma-counted samples were radiochemically analyzed for ^{14}C, ^{55}Fe, ^{63}Ni, ^{90}Sr, ^{129}I, ^{238}Pu, and /sup 239,240/Pu. The gamma-emitting radionuclides in the BRC wastes, which are the primary contributors to the limiting dose to the general population for BRC waste disposal, were dominated by ^{60}Co and ^{137}Cs. The variability in the major gamma-emitting nuclides was assessed as a function of reactor type and waste stream. A similar evaluation was conducted for the difficult-to-measure radionuclides. From these assessments, it was concluded that the variability in radionuclide composition from all waste streams and all plants was sufficiently small to justify the development of a single, conservative radionuclide composition that would be representative of the BRC waste generated at commercial US nuclear power stations.

22036 **(EPRI-NP—5929) CECIL: A robot for secondary-side maintenance of PWR steam generators: Final report.** Lee, R.A.S. (Electric Power Research Inst., Palo Alto, CA (USA); Foster-Miller, Inc., Waltham, MA (USA)). Feb 1989. 103p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report describes the development of a teleoperated robot named CECIL, the Consolidated Edison Combined Inspection and Lancing system for PWR steam generators, from the original evaluation of conventional sludge lancing techniques to the conceptualization of the intertube lancing approach. The report reviews the design and laboratory qualification phases which culminated in the fabrication and first field test of CECIL at Consolidated Edison's Indian Point Unit 2 site in October 1987. 11 refs., 66 figs, 4 tabs.

22037 **(EPRI-NP—6115-M) Intergranular attack of alloy 600: Simulation and remedial action tests: Final report.** Daret, J.; Feron, D. (Electric Power Research Inst., Palo Alto, CA (USA); CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Section d'Etude de la Corrosion Aqueuse; Framatome, 92 - Paris La Defense (France)). Feb 1989. 29p. Research Reports Center, Box 50490, Palo Alto, Ca 94303.

The intergranular attack (IGA) that affects alloy 600 tubes in the tube sheet crevices of PWR steam generators is hard to simulate in laboratory studies. For this study, a special apparatus was designed with a range of representative materials, mechanical conditions and geometry. The design also took account of sludge piles, thermal fluxes and water chemistry. During a first series of seven model boiler tests, chemical parameters and test procedures were adjusted to finally obtain a field prototypical degradation of tubing over a significant length within the tube sheet crevice for the case of caustic pollution. IGA was not produced for the river water inleakage case. A second series of model boiler tests also showed the possibility of producing a representative IGA by initially filling the tube sheet crevices with concentrated caustic solutions. A third series of five model boiler tests aimed at studying in the effectiveness of remedial actions on either virgin of IGA affected tubing. Tube sheet crevice flushing operations using the natural circulation procedure showed a poor efficiency for moving concentrated contaminants, but they succeeded in forcing chemicals additives (acetic acid or boric acid) within the non-occluded portions of crevices. This off-line treatment resulted in a reduction in the progression rate of the pre-existing IGA by a factor of 2 to 3. Simulation of this treatment on virgin material showed that this result was obtained because acetate or borate shifted the cation-to-anion equivalent ratio to well under one. However this off-line treatment could not prevent the occurrence of intergranular stress corrosion cracking (IGSCC) near the top of crevices, since caustic continued to hideout under full power operation. The best remedial action consisted of a combination of off-line and on-line boric acid treatment. IGSCC was prevented both on virgin and IGA affected tubes. 3 figs., 3 tabs.

22038 **(EPRI-NP—6201) PWR steam generator examination guidelines: Revision 2: Final report.** (Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1988. 350p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

PWR steam generator tubing has experienced damage from a wide variety of corrosion and mechanical mechanisms. During the early 1980s, EPRI and the Steam Generator Owners Group (SGOG) informally issued nondestructive evaluation (NDE) guidelines (the 1981 original and a 1984 revision) for the utility community. The purpose of these guidelines was to provide reliable NDE strategies for this diversity of damage mechanisms. With additional industry experience, increased understanding, and the emergence of new NDE technologies, an update and formal release of the guidelines has become appropriate. Based on plant experiences, new research data, and lessons learned from implementing the original guidelines, this revised document will allow utilities to achieve the maximum benefit from periodic steam generator examination. 5 refs., 133 figs., 25 tabs.

22039 **(EPRI-NP—6223) Calculating dynamic crack arrest by static analogy: Final report.** Fabi, R.J.; Ayres, D.J. (Electric Power Research Inst., Palo Alto, CA (USA); Combustion Engineering, Inc., Windsor, CT (USA). Power Systems Group). Mar 1989. 46p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report outlines a new method--the static analogy method--for approximating stress intensity at arrest during fast fracture events and describes two applications. Combustion Engineering (C-E) developed the method for EPRI in the course of detailed examination of dynamic analysis and experimental data on a series of crack arrest experiments. The first application addresses large specimen test results in order to benchmark the method to existing data and analyses. In this application, the project team used the method to analyze results from the C-E/EPRI crack arrest tests, the Heavy-Section Steel Technology (HSST) wide-plate test program, and Oak Ridge National Laboratory pressurized thermal shock experiments. The use of a single analysis technique allowed a comparison of these diverse experiments, placing all data on an equal footing and providing a comparison with small specimen test data from the HSST program. The second application was a fracture mechanics evaluation of a reactor vessel nearing the end of its life. In this evaluation, static analogy method demonstrated that cracks initiated during severe pressurized thermal shock conditions will propagate very much shorter distances than traditional methods have indicated. In particular, it showed that current safety margins may be unnecessarily conservative. 15 refs., 20 figs., 8 tabs.

22040 **(EPRI-NP—6224) Inspecting the circulating water system at Crystal River Unit 3 for evidence of microbial corrosion: Final report.** Hayner, G.O. (Electric Power Research Inst., Palo Alto, CA (USA); Babcock and Wilcox Co., Lynchburg, VA (USA). Research and Development Div.). Mar 1989. 55p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

Portions of the circulating water system (CWS) at the Crystal River-3 nuclear plant were examined for indications of microbiologically influenced corrosion (MIC). This system uses untreated seawater from the Gulf of Mexico for tertiary cooling and has been in operation since 1977. The inspection results indicated that active MIC was present in the inlet piping and probably in other areas in the CWS. Samples removed from nodules and pitted areas revealed high concentrations of viable microorganisms, corrosion products and fatty acids indicative of anaerobic metabolism. MIC was seen only in association with stainless steel weldments. The principal attack was on the interdendritic ferrite in the weld fusion zone. Several changes made over a period of time have apparently resulted in an improvement in condenser tube performance and a reduction in MIC activity in the water boxes since 1986. Several recommendations were made to further reduce or eliminate MIC in the inlet piping. 18 refs., 17 figs., 7 tabs.

22041 **(EPRI-NP—6239) PWR secondary water chemistry guidelines, Revision 2: Final report.** Blomgren, J.C.; Brobst, G.E.; Carr, W.C.; Crinigan, P.T.; Eaker, R.W.; Fredrichs, T.L.; Gatten, T.M.; Gillen, J.; Kerns, M.; Gould, A.J. (Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1988. 179p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

Steam generators in pressurized water reactor (PWR) nuclear power plants have experienced tubing degradation by a variety of corrosion-related mechanisms which depend directly on secondary water chemistry. As a result of this experience, the Electric Power Research Institute has sponsored a major program to provide solutions to PWR steam generator problems. Some of this research was initially conducted under the auspices of the EPRI Steam Generator Owners Groups. More recently, EPRI-sponsored research in this area has been directed by the Steam Generator Reliability Project steering committees. In October 1982 the "PWR Secondary Water Chemistry Guidelines, Rev. O" were published to provide guideline recommendations for critical water chemistry control parameters, available analytical methods, data management and surveillance, and the management philosophy required to successfully implement an effective water chemistry control program. Revision 1 was published in June 1984 reflecting the experiences of implementing the original guidelines and the availability of additional laboratory data. This revision incorporates the use of alternate water chemistries for secondary water chemistry control, based on field and laboratory data regarding mitigation of crevice corrosion. 73 refs., 26 figs., 21 tabs.

22042 **(INIS-mf—11905) Investigation of the effects of the nuclear power plants at Obrigheim, Stade, and Goesgen.** Dosky, D. von. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Bauingenieur- und Vermessungswesen). 9 Jan 1987. 271p. (In German). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88757362/JAW.

This study investigates the effects of power stations - especially when sited in peripheral regions - on the regional economic structure, population structure and settlement structure. The questions of in how far the potential positive effects are actually utilized and of whether they can be integrated into a regional development strategy are also dealt with. In particular, this study discusses the aspects of regional planning policy and energy policy for siting, the space effectiveness of power stations, the economic and employment structure, the regional financial power, infrastructure, settlement structure, furthermore the regional effects during phases of operation and the influence of a shut down on the region concerned. (orig./HSCH).

22043 **(INIS-mf—11925) Obrigheim nuclear power station. Annual report 1987.** Koerner, C. (Kernkraftwerk Obrigheim G.m.b.H. (Germany, F.R.)). [1988]. 76p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757371/JAW.

The Obrigheim nuclear power station was operated at full load during the year 1987; 7.351 operating hours procuded electrical energy of 2.607 GWh. This is the fifth best annual result during Obrigheim's operating period. Since commissioning in October 1968, 139.310 hours of operation have generated 46.681 GWh (gross) and from test operation in March 1969 until the end of 1987, 138.530 hours of operation have generated 46.569 GWh. This is an availability of power of 81.6% in this period and a time availability of 83.9%. In 1987, the plant was shut down for 1.222 hours for the 18th refueling including testing, inspection and repair work. Apart from refueling, the plant had a good time availability and therefore contributed 5% to the safe, economical and environmentally acceptable electricity supply of the Land Baden-Wuerttemberg. The power station is of great significance to the region, both in terms of power supply and the economy.

22044 (INIS-SU—64, pp 66-69) **Measurements of the WWER-1000 reactor core some neutron-physical characteristics.** Kosourov, K.B.; Dukhovenskij, A.S.; Astakhov, S.A. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780053/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 8.

In Nuclear reactor physics and engineering. Scientific-technical collection.

The results of investigations carried out at the South Ukrainian-2 and Novo-Voronezh-5 reactors and aimed at determining the coolant temperature, at which the reactor core becomes critical with inserted control rods are presented. The obtained data are necessary for substantiation of the WWER-1000 reactor safety under accidents followed by high-intense nonsymmetrical reactor shutdown. It is concluded that results of experiments well agree with the calculated parameters which happen to be higher by 14-30 deg C. 4 refs.; 2 tabs.

22045 **(JAERI-M—88-224) Parametric study on thermal-hydraulic characteristics of high conversion light water reactor.** Mori, Takamasa; Nakagawa, Masayuki; Fujii, Sadao. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Nov 1988. 158p. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88757261/JAW.

To assess the feasibility of high conversion light water reactors (HCLWRs) from the thermal-hydraulic viewpoint, parametric study on thermal-hydraulic characteristics of HCLWR has been carried out by using a unit cell model. It is assumed that a HCLWR core is contained in a current 1000 MWe PWR plant. At the present study, reactor core parameters such as fuel pin diameter, pitch, core height and linear heat rate are widely and parametrically changed to survey the relation between these parameters and the basic thermal-hydraulic characteristics, i.e. maximum fuel temperature, minimum DNBR, reduction of reactor thermal output and so on. The validity of the unit cell model used has been ensured by comparison with the result of a subchannel analysis carried out for a whole core.

22046 (Juel-Conf—62, pp 150-160) **Disassembly, pre-decontamination, and conditioning of scrap for subsequent melting.** Graebener, H. (Siemens A.G. Unternehmensbereich KWU, Offenbach am Main (Germany, F.R.)). Jul 1988. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW. (CONF-8711296—).

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

Measuring methods hitherto applied for radiological decontrol of decommissioned reactor components required very much time and personnel. The paper in hand explains a new approach that has been tested on laboratory scale. The low-level radioactive metallic components (below 74 Bq/g) are disassembled by various methods into scrap pieces of the size fitting into commercially available 200 l waste drums, and are shipped for melting in a foundry where the first measured radiological data are compared with the radioactivity data measured in the melt, slag, and filter deposits. A computer code allows complete accounting of activities and materials prior to and after melting.

22047 **(NUREG/CR—4849-Vol.1) Steam Generator Group Project: Task 9 final report, Nondestructive evaluation round robin: Volume 1, Description and summary data.** Doctor, P.G.; Harty, H.; Ferris, R.H.; Birks, A.S. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Pacific Northwest Lab., Richland, WA (USA)). Jan 1989. Contract AC06-76RL01830. 345p. (PNL—5868-Vol.1). NTIS, PC A15/MF A01 - GPO - OSTI. Order Number TI89008770/JAW.

The Steam Generator Group Project (SGGP) is using the retired-from-service Surry 2A pressurized water reactor steam generator as a test bed to investigate the reliability and effectiveness of inservice nondestructive eddy current inspection equipment and procedures. The information developed will provide the technical basis for updating the Regulatory Guides governing inservice inspection and tube plugging criteria of steam generators. This report describes Task 9 of the multi-task project. The objective of Task 9 was to plan, perform and analyze results of four round robin nondestructive examinations on a subset of tubes from the Surry generator. A description of the objectives, conduct and analysis of results for each round robin is presented. Validation of inspection results will be provided by removal of specimens from the generator for destructive and out-of-generator characterization (in progress). Pre-

liminary comparisons of the inspection results in terms of agreement among teams of defect detection and sizing are given for each round robin. The majority of indications were reported at the hot leg top of the tube sheet. The best results on detection agreement ranged between 70 and 90 percent, but reported defect sizes varied significantly between teams for all round robins. The variability in detection and sizing appears to be due to analyst interpretation of the complex eddy current signals rather than differences in inspection equipment. 5 refs., 20 figs., 33 tabs.

22048 **(NUREG/CR—4849-Vol.2) Steam Generator Group Project: Task 9 final report, Nondestructive evaluation round robin: Volume 2, Raw inspection data.** Doctor, P.G.; Harty, H.; Ferris, R.H.; Birks, A.S. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Pacific Northwest Lab., Richland, WA (USA)). Mar 1989. Contract AC06-76RL01830. 678p. (PNL—5868-Vol.2). NTIS, PC A99/MF A01 - GPO - OSTI. Order Number TI89008771/JAW.

The Steam Generator Group Project (SGGP) is using the retired-from service Surry 2A pressurized water reactor steam generator as a test bed to investigate the reliability and effectiveness of inservice nondestructive eddy current inspection equipment and procedures. The information developed will provide the technical basis for updating the Regulatory Guides governing inservice inspection and tube plugging criteria of steam generators. This report describes Task 9 of the multi-task project. The objective of Task 9 is to plan, perform and analyze results of four round robin nondestructive examinations on a subset of tubes from the Surry generator. A description of the objectives, conduct and analysis of results for each round robin is presented. Validation of inspection results will be provided by removal of specimens from the generator for destructive and out-of-generator characterization (in progress). Preliminary comparisons of the inspection results in terms of agreement among teams of defect detection and sizing are given for each round robin. The majority of indications were reported at the hot leg top of the tube sheet. The best results on detection agreement ranged between 70 and 90 percent, but reported defect sizes varied significantly between teams for all round robins. The variability in detection and sizing appears to be due to analyst interpretation of the complex eddy current signals rather than differences in inspection equipment.

22049 **(ORNL/tr—89/14) Apparatus for localizing disturbances in pressurized water reactors (PWR).** Sykora, D. (Oak Ridge National Lab., TN (USA)). [1989]. Contract AC05-84OR21400. Translation of German Patent 1575 25, December 18, 1976. 17p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008863/JAW.

The invention according to CS-PS 177386, entitled "Apparatus for increasing the efficiency and passivity of the functioning of a bubbling-vacuum system for localizing disturbances in nuclear power plants with a pressurized water reactor", concerns an important area of nuclear power engineering that is being developed in the RGW member countries. The invention solves the problems of increasing the reliability and intensification during the operation of the above very important system for guaranteeing the safety of the standard nuclear power plants of Soviet design. The essence of the invention consists in the installation of a simple passively operating supplementary apparatus. Consequently, the following can be observed in the system: first an improvement and simultaneous increase in the reliability of its function during the critical transition period, which follows the filling of the second space with air from the first space; secondly, elimination of the hitherto unavoidable initiating role of the active sprinkler-condensation device present; thirdly, a more effective performance and subjection of the elements to disintegration of the water flowing from the bubbling condenser into the first space; and fourthly, an enhanced utilization of the heat-conducting ability of the water reservoir of the bubbling condenser. Representatives of the supplementary apparatus are autonomous and local secondary systems of the sprinkler-sprayer without an insert, which spray the water under the effect of gravity. 1 fig.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 21810, 21833, 21838, 22139, 22142, 23228

22050 **(AEEW-R—2377) WIMS-E module W-SPECTROX.** Roth, M.J. (UKAEA Atomic Energy Establishment, Winfrith (UK). Reactor Physics Div.). Jun 1988. 6p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705613/JAW.

W-SPECTROX is a new module in the WIMS-E reactor physics calculational scheme. Its function is to calculate collision probabilities for an approximate model of a fuel cluster, consisting of an average fuel pin, clad and coolant, surrounded by a bulk moderator. Its application is therefore aimed primarily at AGR (or similar) assembly calculations. Within WIMS-E, the smearing module W-SMEAR is used to generate the simple model that is input to W-SPECTROX and in general, the flux solution module W-PIP is then used to generate fluxes typical of the flux, can, coolant and moderator regions of the problem. These fluxes are used to condense the energy group structure of the problem and/or to perform a spatial smearing of the rings of fuel pins. By choosing an appropriate condensation and smearing, computing times can be much reduced in a subsequent more detailed spatial solution of the problem. This report describes where the new module fits into WIMS-E and how to use it.

22051 **(CONF-890186—1) Methods for very high temperature design.** Blass, J.J.; Corum, J.M.; Chang, S.J. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 19p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007204/JAW.

From Workshop on structural design criteria for HTR; Julich, F.R. Germany (31 Jan 1989).

Design rules and procedures for high-temperature, gas-cooled reactor components are being formulated as an ASME Boiler and Pressure Vessel Code Case. A draft of the Case, patterned after Code Case N-47, and limited to Inconel 617 and temperatures of 982{degree}C (1800{degree}F) or less, will be completed in 1989 for consideration by relevant Code committees. The purpose of this paper is to provide a synopsis of the significant differences between the draft Case and N-47, and to provide more complete accounts of the development of allowable stress and stress rupture values and the development of isochronous stress vs strain curves, in both of which Oak Ridge National Laboratory (ORNL) played a principal role. The isochronous curves, which represent average behavior for many heats of Inconel 617, were based in part on a unified constitutive model developed at ORNL. Details are also provided of this model of inelastic deformation behavior, which does not distinguish between rate-dependent plasticity and time-dependent creep, along with comparisons between calculated and observed results of tests conducted on a typical heat of Inconel 617 by the General Electric Company for the Department of Energy. 4 refs., 15 figs., 1 tab.

22052 **(INIS-GB—176) National Nuclear Corporation Limited report and financial statements 31 March 1988.** (National Nuclear Corp. Ltd., London (UK)). 1988. 19p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705766/JAW.

The Group is engaged in designing and constructing power stations and nuclear power reactors and other related work and in associated research and development. Work on the Advanced Gas Cooled Reactor Power Stations at Heysham II and Torness has continued during the year. A variety of work continues to be undertaken on completed stations at Hinkley Point 'B', Heysham I, Hartlepool and Dungeness 'B' through the company's Operational Support Unit which was formed during the year. The Unit is pursuing work on other nuclear stations. Work on the Sizewell 'B' PWR under the Central Electricity Generating Board's Project Management Team is proceeding well. In June 1988 the company was awarded a contract to assist the Ministry of Defence in the management of several major projects. The accounts are presented. It is shown that the profit available to the shareholders for the year ended 31 March 1988 is Pound 4,219,000. Research and develop-

ment has been undertaken on AGRs, PWRs and fast reactors. Its technologies cover chemistry, materials, heat transfer, fluid flow, mechanical engineering and instrumentation.

22053 (INIS-SU—75, pp 3-8) **Forecasting the radiation conditions in the box of deaerator and steam separator at the Bilibino NPP.** Bychkov, Ya.A.; Baboshin, N.G.; Engovatov, I.A.; Koltun, O.V.; Lavdanskij, P.A.; Stepkin, S.I. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780081/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Construction and building. Scientific-technical collection.

Data on the γ-radiation dose rate fields for the Bilibino NPP unprotected deaerator and steam separator equipment, calculated according to the KONTUR program and measured using the DRG3-02 dosemeter are presented. A possibility of computerized forecasting of sufficiently non-uniform dose rate fields with 20-40% error using the KONTUR program is demonstrated as a result of analysis conducted for radiation of /sup 16/N and corrosion product isotopes. 2 refs.; 3 tabs.

22054 **(JAERI-M—88-220) Irradiation performance of thorium oxide based coated particle fuels.** Shiratori, Tetsuo; Itoh, Akinori; Akabori, Mitsuo; Shiba, Koreyuki; Adachi, Mamoru. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Nov 1988. 65p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88757257/JAW.

BISO coated ThO/sub 2/ particles as fertile fuel and BISO or TRISO coated (Th, U)O/sub 2/ particles as fissile fuel for a High-temperature Gas-cooled Reactor (HTGR) were irradiated to investigate particle performances in loosely-packed condition of two capsules in JRR-2 and one capsule in JMTR. Irradiation of these coated particles was achieved to a maximum fast neutron fluence of 2.22 x 10/sup 21/ neutrons/cm/sup 2/ (E > 0.18 MeV) and a maximum thermal neutron fluence of 1.35 x 10/sup 21/ neutrons/cm/sup 2/ at temperatures of 770 to 1225 deg C. And a maximum burnup of fissile particles was 2.42 % FIMA. It was found in the post-irradiation examinations that the coated particles were intact except a little of the BISO coated fissile particles, and the thorium oxide based coated particles performed well under the irradiation conditions. The data were also taken on the fission product behavior released from the fuel kernels during the irradiation. And density of the outer LTIPyC (OPyC) increased as increasing the fluence of fast neutron. As a result of the densification of the OPyC, the crushing strength of the BISO coated particles increased, otherwise the TRISO coated particles decreased.

22055 **(JAERI-M—88-245) Accuracy investigation of nuclear design method for High Temperature Engineering Test Reactor (HTTR) based on VHTRC experimental data.** Yamashita, Kiyonobu; Shindo, Ryuichi; Murata, Isao; Watanabe, Takashi. (Japan Atomic Energy Research Inst., Oarai, Ibaraki. Oarai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Dec 1988. 94p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757274/JAW.

The accuracy investigation of nuclear design method for High Temperature engineering Test Reactor (HTTR) has been done through the comparison with various experimental data obtained using the Very High Temperature Reactor Critical Assembly (VHTRC). The nuclear design codes used in this study are DELIGHT-6, 7 to obtain the neutron sepectrum of a fuel cell and to produce group constants utilizing the nuclear data from ENDF/B-3, 4, CITATION and CITATION-1000VP to calculate the three dimensional core performance, and TWOTRAN-2 for control rod cell calculation. The nuclear design method was examined by this study on the integral quantities of effective multiplication factor, control rod reactivity worth, burnable poison rod reactivity worth, power distribution and temperature coefficient. The maximum degrees of disagreement of the aforementioned items with relevant experiments were found to be 1.0 %Δk, 9.5 %, 4.5 %, 2.9 % and 7.0 %, respectively.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 22672

22056 (Juel-Conf—62, pp 66-91) **Waste management concept for the Niederaichbach reactor station.** Loeschhorn, U.; Zimmermann, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projektbereich Anlagen). Jul 1988. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW. (CONF-8711296—).

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

The KKN reactor station was decommissioned in 1974, and after dismantling of the contaminated components and subsequent disposal in the reactor containment, the power station was safely enclosed. The licences required for total dismantling of the reactor were issued in 1987. The paper explains the preparatory work for dismantling, which covers categorization of the various waste materials and components (into almost non-radioactive material, reusable material, radioactive material). Other tasks explained include the extensive sampling and analysing programme, the measuring programme and the relevant documentation of data. Information is given on the radiation exposure of the personnel, and on the maximum permissible radiation doses determined by the dismantling licences, including the limits set for general, almost non-radioactive waste.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 21753, 22099, 22102, 22103, 22105, 22250

22057 **(CONF-890218—3) Actinide recycle potential in the IFR [Integral Fast Reactor].** Chang, Y.I. (Argonne National Lab., IL (USA)). 1989. Contract W-31109-ENG-38. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008048/JAW.

From 16. annual WATTec conference and exhibition; Knoxville, TN, USA (14 Feb 1989).

Rising concern about the greenhouse effect reinforces the need to reexamine the question of a next-generation reactor concept that can contribute significantly toward substitution for fossil-based energy generation. Even with only the nuclear capacity on-line today, world-wide reasonably assured uranium resources would last for only about 50 years. If nuclear is to make a significant contribution, breeding is a fundamental requirement. Uranium resources can then be extended by two orders of magnitude, making nuclear essentially a renewable energy source. The key technical elements of the IFR concept are metallic fuel and fuel cycle technology based on pyroprocessing. Pyroprocessing is radically different from the conventional PUREX reprocessing developed for the LWR oxide fuel. Chemical feasibility of pyroprocessing has been demonstrated. The next major step in the IFR development program will be the full-scale pyroprocessing demonstration to be carried out in conjunction with EBR-II. IFR fuel cycle closure based on pyroprocessing can also have a dramatic impact on the waste management options, and in particular on the actinide recycling. 6 figs.

22058 **(DOE/EA—0258-Rev.1) Environmental assessment for Breeder Reprocessing Engineering Test (BRET): Revision 1.** Lerch, R.E. (USDOE Richland Operations Office, WA). Mar 1989. 114p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008796/JAW.

This Environmental Assessment (EA) is for the proposed installation and operation of an integrated breeder fuel reprocessing test system in the shielded cells of the Fuels and Materials Examination Facility (FMEF) at Hanford and the associated modifications to the FMEF to accommodate BRET. These modifications would begin in FY-1986 subject to Congressional authorization. Hot operations would be scheduled to start in the early 1990's. The system, called the Breeder Reprocessing Engineering Test (BRET), is being designed to provide a test capability for developing the

demonstrating fuel reprocessing, remote maintenance, and safeguards technologies for breeder reactor fuels. This EA describes (1) the action being proposed, (2) the existing environment which would be affected, (3) the potential environmental impacts from normal operations and severe accidents from the proposed action, (4) potential conflicts with federal, state, regional, and/or local plans for the area, and (5) environmental implications of alternatives considered to the proposed action. 41 refs., 10 figs., 31 tabs.

22059 **(ENEA-RT-VEL—88-4) Fast breeder reactor reference system classification for the ENEA data bank.** Righini, R. (ENEA, Bologna (Italy)). (ENEA, Bologna (Italy). Dipt. Reattori Veloci). 1988. 315p. NTIS (US Sales Only), PC A14/MF A01 - OSTI; INIS. Order Number DE88705624/JAW.

This report contains the Reference System Classification (RSC) of fast breeder reactors: it provides a functional system breakdown of the reactor. For each system the following important characteristics are reported: the main function, the mode of operation, its location in the reactor, the main interface system, its main components and the component working environment (fluid and/or atmosphere type). The RSC represent a basic step in organizing the ENEA data bank for the registration and processing of reliability data on typical fast reactor components; it provides a functional component breakdown and represent a plant-unique identification in the process of omogenization of event-data coming from different reactors. In this report it was tried to take into account different generations of nuclear power plants, different plant layouts and solutions: in particular loop and pool reactors are separately treated.

22060 **(HEDL-SA—3702) Five years operating experience at the Fast Flux Test Facility.** Baumhardt, R.J.; Bechtold, R.A. (Westinghouse Hanford Co., Richland, WA (USA)). 1 Apr 1987. Contract AC06-87RL10930. 11p. (CONF-870917—10). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008790/JAW.

From ANS/ENS international conference on fast breeder reactor systems: experience gained and path to economical power generation; Richland, WA, USA (13 Sep 1987).

The Fast Flux Test Facility (FFTF) is a 400 Mw(t), loop-type, sodium-cooled, fast neutron reactor. It is operated by the Westinghouse Hanford Company for the United States Department of Energy at Richland, Washington. The FFTF is a multipurpose test reactor used to irradiate fuels and materials for programs such as Liquid Metal Reactor (LMR) research, fusion research, space power systems, isotope production and international research. FFTF is also used for testing concepts to be used in Advanced Reactors which will be designed to maximize passive safety features and not require complex shutdown systems to assure safe shutdown and heat removal. The FFTF also provides experience in the operation and maintenance of a reactor having prototypic components and systems typical of large LMR (LMFBR) power plants. The 5 year operational performance of the FFTF reactor is discussed in this report. 6 refs., 10 figs., 2 tabs.

22061 **(PNL-SA—15471) Neutron-induced swelling of commercial alloys at very high exposures.** Garner, F.A.; Gelles, D.S. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 20p. (CONF-880613—29). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007235/JAW.

From 14. international symposium on effects of radiation on materials; Andover, MA, USA (27 Jun 1988).

Density change measurements have been completed on a wide variety of commercially available structural alloys irradiated to neutron fluence levels as large as 2.8 {times} 10^{23} n/cm^2 (E > 0.1 MeV) or {approximately}140 dpa in EBR-II at eight temperatures between 399 and 650{degree}C. While there was essentially no swelling in some ferritic alloys and some austenitic superalloys, other austenitic alloys exhibited a wide range of swelling depending on composition, heat treatment and irradiation temperature. The swelling behavior of the austenitic alloy system is shown to reflect primarily the influence of the overall composition and the irradiation temperature on the duration of the transient regime of void swelling, and secondarily to reflect the influence of precipitation and cold work. 16 refs., 6 figs., 5 tabs.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

REFER ALSO TO CITATION(S) 22212

22062 **(WHC-SA—0457) Postirradiation examination of thermionic fuel element specimens.** Cannon, N.S.; Lawrence, L.A.; Veca, A.R. (Westinghouse Hanford Co., Richland, WA (USA); General Atomics, San Diego, CA (USA)). Dec 1988. Contract AC06-87RL10930. 6p. (CONF-890103—9). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008709/JAW.

From 6. symposium on space nuclear power systems; Albuquerque, NM, USA (9 Jan 1989).

The Thermionic Fuel Element (TFE) Verification Program is funded by the Department of Energy (DOE) with the objective of demonstrating a fuel element design for a multimegawatt-class thermionic reactor for space power systems (Bohl and Ranken 1987). A number of contractors and DOE laboratories are involved in this program. These include General Atomics (GA), which is responsible for the overall technical development, fabrication, and processing of components and TFE prototypes for fast reactor testing and Westinghouse Hanford Company (WHC), which has the responsibility for implementation of the fast reactor irradiation program. 1 ref., 3 figs.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 21791, 21876, 21877, 22105

22063 **(INIS-XN—150) Order of 21 October 1988 withdrawing the licence for the release of gaseous radioactive effluents by the Cattenom nuclear production centre (Units 1 and 2).** (International Atomic Energy Agency, Vienna (Austria)). Oct 1988. 1p. (In French). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706177/JAW.

Published in the Journal Officiel de la Republique francaise.

The Court of Justice of the European Communities decided on 22 September 1988 that the Commission of the European Communities had to be notified and give its opinion before the competent authorities of Member States authorised the release of radioactive effluents from a nuclear installation. In compliance with that judgment, this Order repeals an Order of 21 February 1986 licensing such release (NEA).

22064 **(INIS-XN—151) Order of 21 October 1988 on licensing the release of gaseous radioactive effluents by the Cattenom nuclear production centre (units 1 and 2).** (International Atomic Energy Agency, Vienna (Austria)). Oct 1988. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706178/JAW.

Published in the Journal Officiel de la Republique francaise.

This Order fixes the conditions and limits of authorised releases of gaseous radioactive effluents from Units 1 and 2 of the Cattenom nuclear power plant. The annual limits are 1650 terabecquerels for gas and 55 gigabecquerels for gaseous halogens and aerosols. The Order specifies these are maximum limits, below which the radioactive releases should be as low as possible. (NEA).

22065 **(INIS-XN—152) Order of 21 October 1988 on licensing the release of liquid radioactive effluents by the Cattenom nuclear production centre (units 1 and 2).** (International Atomic Energy Agency, Vienna (Austria)). Oct 1988. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706179/JAW.

Published in the Journal Officiel de la Republique francaise.

This Order fixes the conditions and limits of authorized releases of liquid radioactive effluents from units 1 and 2 of the Cattenom nuclear power plant. The annual limits are 1.1 terabecquerel for radioelements other than tritium, potassium 40 and radium and 80 terabecquerels for tritium. The Order specifies these are maximum limits, below which the radioactive releases should be as low as possible. (NEA).

22066 **(INIS-XN—168) S.I.1988 No. 1138, The Air Navigation (Restriction of Flying) (Nuclear Installations) Regulations 1988.** (International Atomic Energy Agency, Vienna (Austria)). 1 Jul 1988. 3p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706195/JAW.

On 25 August 1988 the Air Navigation (Restriction of Flying) (Nuclear Installations) Regulations 1988 (SI 1988/1138) made pursuant to the Air Navigation Order 1985 (SI 1985/1643) came into force. The Regulations prohibit, subject to specified exceptions, aircraft from flying below prescribed heights over nuclear installations. They replace the Air Navigation (Restriction of Flying) (Atomic Energy Establishments) Regulations 1983 (SI 1983/640). (NEA).

22067 **(INIS-XN—169) S.I. 1987 No. 2182, The Electricity Generating Stations and Overhead Lines (Inquiries Procedure) Rules 1987.** (International Atomic Energy Agency, Vienna (Austria)). 16 Dec 1987. 9p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706196/JAW.

These Rules, which came into force on 14 January 1988, make new provision for the procedure for any public inquiry held pursuant to Section 34 of the Electricity Act 1957 in relation to applications for consent to construct or extend a generating station (including nuclear stations). The Rules were made pursuant to Section 11 of the Tribunals and Inquiries Act 1971. They revoke the previous Electricity Generating Stations and Overhead Line (Inquiries Procedures) Rules 1981. These new Rules cover the same topics as the previous Rules but aim to shorten the potential length and thus cost of inquiries. They will apply to the Inquiry to be held into the application by the Central Electricity Generating Board to build a pressurised water reactor at Hinkley Point in Somerset. (NEA).

22068 **(INIS-XN—171) Order of 21 October 1988 withdrawing the licence for the release of liquid radioactive effluents by the Cattenom nuclear production centre (units 1 and 2).** (International Atomic Energy Agency, Vienna (Austria)). Oct 1988. 1p. (In French). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706198/JAW.

Published in the Journal Officiel de la Republique francaise.

The Court of Justice of the European Communities decided on 22 September 1988 that the Commission of the European Communities had to be notified and give its opinion before the competent authorities of Member States authorised the release of radioactive effluents from a nuclear installation. In compliance with that judgment, this Order repeals an Order of 21 February 1986 licensing such release (NEA).

22069 (Juel-Conf—62, pp 1-11) **Reuse of solid waste from repair and dismantling work - administrative aspects of the practice adopted in the FRG.** Eder, E. (Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany, F.R.)). Jul 1988. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW. (CONF-8711296—).

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

As the transitional process of radioactive waste, or replaced or dismantled components from nuclear facilities, becoming non-active or decontaminated material is a process varying in time and many other parameters, there should be applied standard administrative, legal procedures of treating such material leaving the scope of atomic energy law due to loss of radioactivity. Regulatory control of the decontaminated material for reuse relies on dose calculations which in future should also take into account the exposure pathway of radioactive solid waste material in addition to pathways of water and air. The proposed value for the individual dose limit, about 0.1 mSv/a, is regarded to be appropriate and feasible.

22070 (Juel-Conf—62, pp 12-23) **Current discussions within the IAEA and the EC about dose limits.** Neider, R. (Bundesanstalt fuer Materialforschung und -pruefung, Berlin (Germany, F.R.)). Jul 1988. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW. (CONF-8711296—).

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

The dose limits determined by the Radiation Protection Ordinance and the international radiation protection guides cannot be applied to decontaminated components or material for reuse, as this category of material has not been taken into account at the time the guides and regulations were set up. Meanwhile, both within the IAEA and the EC, work has been started to revise the existing dose limits in the light of recent findings and the principles of ICRP publication 26.

22071 (Juel-Conf—62, pp 126-135) **Problems involved in radiological measurements for maximum permissible dose determination.** Zaddach, G.; Zange, E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Abt. Dekontamination). Jul 1988. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW. (CONF-8711296—).

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

The paper shows and discusses the problems encountered with the radiological measurements, choosing in particular examples of steel scrap measurements. The methods applied for practical measurements are also explained.

22072 **(KAERI/RR—569/86) Study on optimization of the nuclear safety system.** Lee, Sang Hoon; Koh, Byung Joon; Kim, Jin Soo; Kim, Byoung Do; Cho, Seong Won; Kwon, Seog Kwon; Choi, Kwang Sik. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Dec 1986. 379p. (In Korean). NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705863/JAW.

The number of nuclear facilities (nuclear power plants, research reactors, nuclear fuel facilities) under construction or in operation in Korea continues to increase and this has brought about increased importance and concerns toward nuclear safety in Korea. Also, domestic nuclear related organizations are increasingly carrying out the design/construction of nuclear power plants and the development /supply of nuclear fuels. In order to flexibly respond to these changes and to suggest direction to take, it is necessary to re-examine the current nuclear safety regulation system. This study is carried out in two stages and this report describes the results of the analysis and the assessment of the nuclear licencing system of such foreign countries as Sweden and German, as the first of the two. In this regard, this study includes the analysis on the backgrounds on the choice of nuclear licensing system, the analysis on the licensing procedures, the analysis on the safety inspection system and the enforcement laws, the analysis on the structure and function of the regulatory, business and research organizations as well as the analysis on the relationship between the safety research and the regulatory duties. In this study, the German safety inspection system and the enforcement procedures and the Swedish nuclear licensing system are analyzed in detail. By comparing and assessing the finding with the current Korea Nuclear Licensing System, this study points out some reform measures of the Korean system that needs to improved. With the changing situations in mind, this study aims to develop the nuclear safety regulation system optimized for Korean situation by re-examining the current regulation system.

22073 **(NUREG—0540-Vol.10-No.12) Title list of documents made publicly available, December 1--31, 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services). Feb 1989. 318p. NTIS, PC A14/MF A01 - GPO - OSTI. Order Number TI89008913/JAW.

This monthly publication contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes docketed material associated with civilian power plants and other uses of radioactive materials and nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index. The docketed information contained in the Title List includes the information formerly issued through the Department of Energy publication Power Reactor Docket Information, last published in January 1979. Microfiche of the docketed information listed in the Title List is available for sale on a subscription basis from the National Technical Information Service (NTIS).

22074 **(NUREG—0940-Vol.7-No.4) Enforcement actions: Significant actions resolved: Quarterly progress report, October--December 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Enforcement). Feb 1989. 394p. NTIS, PC A17/MF A01 - GPO - OSTI. Order Number TI89008633/JAW.

This compilation summarizes significant enforcement actions that have been resolved during one quarterly period (October--December 1988) and includes copies of letters, Notices, and Orders sent by the Nuclear Regulatory Commission to licensees with respect to these enforcement actions. It is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activities licensed by the NRC, so that actions can be taken to improve safety by avoiding future violations similar to those described in this publication.

22075 **(NUREG/CR—2000-Vol.8-No.1) Licensee event report (LER) compilation: For month of January 1989.** (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data; Oak Ridge National Lab., TN (USA)). Feb 1989. Contract AC05-84OR21400. 127p. (ORNL/NSIC—200-Vol.8-No.1). NTIS, PC A07/MF A01 - GPO - OSTI. Order Number TI89008298/JAW.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-1061, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73--Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983. NUREG-1022, Licensee Event Report System--Description of Systems and Guidelines for Reporting, provides supporting guidance and information on the revised LER rule.

22076 **(R—8509372-S12S) Country plan Middle-Zeeland. Design first partial review country plan Middle-Zeeland regarding the location of new nuclear power plants.** (Provinciale Staten Zeeland, Middelburg (Netherlands)). 4 Dec 1985. 8p. (In Dutch). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706270/JAW.

In the 'Streekplan Midden-Zeeland' as assessed by the Provincial government of Zeeland May 7th 1982, the location of additional nuclear power plants is ruled out. This policy was based upon the motion of the Provincial government October 21st 1977 following which extension of nuclear power in Zeeland is, as yet, unacceptable. The Dutch national government, however, has the point of view that the future deficiency of electric power can be supplemented best by nuclear power and has decided the location of at least two new nuclear power plants. Six locations have been selected for which the national government supposes no decisive objections to be present. The national government has given its view that Borssele is the most attractive of these locations. Thus, the provincial government has reviewed its policy and has taken the view that the motion of 21st October 1977 applies no longer. Some procedural aspects are discussed, the consequences for the existing town and country planning are described and the modifications arising from this Streekplan are described. 3 refs.

2108 Economics

REFER ALSO TO CITATION(S) 22240, 22241, 22242, 22243, 22244

22077 **(DOE/RL—88-06) Hanford site strategic facilities plan: Site planning.** (Westinghouse Hanford Co., Richland, WA (USA)). Apr 1988. Contract AC06-87RL10930. 494p. NTIS, PC A21/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008223/JAW.

This plan revises the first Hanford Site Strategic Facilities Plan submitted by Rockwell Hanford Operations in 1987. A methodology is provided and supporting projects are proposed to enhance the operating efficiency of the Hanford Site as required by the Strategic Facilities Initiative (SFI), Detailed Guidance for Execution of the FY 1990 Program. Mission changes (Basalt Waste Isolation Project, 100-N Area Reactor/Fuels Fabrication, and the SP-100 Program) occurred during the preparation of this plan. All the Basalt Waste Isolation Project and some of the 100-N Reactor/Fuels Fabrication Facility impacts were incorporated. Approximately 1270 facilities consisting of buildings (e.g., shops, warehouses, plants, offices) and other structures (e.g., roads, transformers, water lines) were evaluated. Of these 1270 facilities, 186 were underutilized and classified as "marginal." Each marginal (underutilized) facility is provided with a recommendation for disposition. Of the 186 marginal facilities, 57 are recommended for SFI action (conversion, consolidation, deactivation, disposal, demolition, or other) and 129 are recommended for no SFI action. 15 refs.

22078 **(JAERI-M—88-186) Development of the financial model for analyses on economic performances of nuclear facilities and examples of its applications.** Mankin, Shuichi; Ueno, Seiichi; Kimura, Shigeru; Yuasa, Tadao. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Oct 1988. 94p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757244/JAW.

On the assumption of the commercialization stage of technologies, the analysis on performances in financial operation based on simulation studies is one of important study subjects in the field of the system analysis and economic assessments of nuclear technologies. However, economic assessments on financial performances of such complex industries as nuclear power based on nuclear fuel cycle industries, or as electric utilities composed of hydro, fossil, nuclear power stations are complicated, and the adoption of conventional financial model is insufficient in the case of nuclear technologies which have such special financial process as decommissioning. We, therefore, develop the computer simulation model that can analyze financial performances of nuclear facilities. In this report, the derivation of equations and outlines of the model are explained. Additionally, examples of hypothetical financial simulation studies on a coal-gasoline plant, nuclear waste industries, and analysis on economic perspectives of small size nuclear reactors for electric utilities are indicated.

22079 **(SPH—01-00) Summary project for review of nuclear power.** Zorn, G.W.H. (ed.); Berenschot B.V., Utrecht (NL). (Stuurgroep Project Herbezinning, The Hague (Netherlands)). May 1988. 100p. (In Dutch). Library, KNAW; Postbus 41950, 1096 DD Amsterdam, Netherlands.

A summary is presented of the results of study collected in the project Review Nuclear Power. The government and parliament have decided, in consequence of the accident at Chernobyl that still more information should be available before the decision making about further application of nuclear power in behalf of the electricity supply could be continued. The results can be divided in five main themes: the analysis of Chernobyl and the international reactions; safety aspects in nuclear power plants; impact of a nuclear accident on the environment; external measures against nuclear

accidents; and the economical damage caused by a nuclear accident. The separate summaries of the twenty reports which have been made in this context, are included in the appendices of this summary. With this report the first stage of the review is finished. This stage of study and collection of information will be followed by advisements about it by various advisements authorities. After that the government point of view will be formulated and the deliberation between government and parliament can take place. 1 figure; tabs.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

22080 **(AEEW-R—2385) Square boundary version of the WIMSE module W-PIJ.** Halsall, M.J. (UKAEA Atomic Energy Establishment, Winfrith (UK). Reactor Physics Div.). Aug 1988. 31p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705614/JAW.

W-PIJ is one component of the modular reactor physics code scheme known as WIMS-E. Its purpose is to read cross section data from a WIMS-E interface, a two dimensional cluster geometry from user input, and to calculate the associated region to region first flight neutron collision probabilities. These it writes back to the interface as data for a solution module which can calculate fluxes. Recent modifications to the code have provided better data checking facilities including a lineprinter geometry plotting option, and the option of an explicit square outer boundary. This report briefly describes the modifications that have been made to the code and includes a complete user guide to all options, old and new.

22081 **(BNL-NCS—41883) A warning on fission resonance intergrals: Caveat utor.** Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). [1988]. Contract AC02-76CH00016. 5p. (CONF-890406—5). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89002182/JAW.

From Fifty years with nuclear fission conference; Gaithersburg, MD, USA (25 Apr 1989).

A common error is made in defining the resonance integral in most tabulations and handbooks. Although it has a minor effect on the capture resonance integral and on the fission resonance integral for the fissile nuclides, it leads to gross errors in the fission resonance integral for the fertile nuclides. The errors in the fission resonance integral for fertile nuclides of the elements from thorium through curium in the ENDF/B-V library will be presented. Let the user beware.

22082 **(JAERI-M—88-221) Reactor Engineering Department annual report (April 1, 1987 - March 31, 1988).** (Japan Atomic Energy Research Inst., Tokyo). Nov 1988. 254p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88757258/JAW.

This report summarizes the research and development activities in the Department of Reactor Engineering during the fiscal year of 1987 (April 1, 1987 - March 31, 1988). The major activities in the Department concerns the programs of the high temperature gas-cooled reactor, the high conversion light water reactor, the advanced fission reactor system and the fusion reactor at JAERI and the fast breeder reactor at PNC. The report contains the latest progress in nuclear data and group constants, theoretical methods and code development, reactor physics experiments and analyses, fusion neutronics, shielding, reactor and nuclear instrumentation, reactor control/diagnosis and robotics, as well as the new topics from this fiscal year on advanced reactors system design studies and technique developments related the facilities in the Department. Also described are the activities of the Research Committee on Reactor Physics.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 21964, 22141, 22164, 22253, 22485, 22658, 22821, 22834

22083 **(AEEW-M—2395) Pipe whip and impact. A review of the literature.** Attwood, G.J. (UKAEA Atomic Energy Establishment, Winfrith (UK). Safety and Engineering Science Div.). Jan 1987. 25p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705941/JAW.

Over the past few years changes in economic and safety considerations in nuclear power plants have resulted in a need to examine the problem of pipe whip in greater detail. Consequently, experimental programmes were set up in France, North America and Britain. Results from these tests combined with analytical work indicate that pipe whip followed by impact with surrounding pipework and structures may not be as serious as had been believed. Impact loads have been found to be much less (at least five times) than those predicted to the appropriate design regulations. Hence, the use of pipe whip restraints may have been overconservative. The use of fewer, better designed restraints, would result in greater accessibility of pipework, a reduced need for inspection of restraints, and a considerable financial saving.

22084 **(AEEW-R—2125) Impact resistance of mild steel pipes: an experimental study.** Neilson, A.J.; Howe, W.D.; Garton, G.P. (UKAEA Atomic Energy Establishment, Winfrith (UK). Safety and Engineering Science Div.). Jun 1987. 40p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705948/JAW.

This report describes the results of 43 impact tests on 152 mm (6 in) nominal bore steel pipes. The missiles included solid steel billets and sections of steel pipe with impact velocities in the range 46 to 325 ms/sup -1/. The tests showed that, for the solid billets, the impact resistances of the pipes were greater than expected from previous tests on flat plates. The perforation energies have been correlated against normalised target wall thickness and relative diameter of missile and target. The results of non-circular section missiles can be predicted using an equivalent circular missile based on the length of the perimeter. The correlation provides satisfactory indications of the results obtained with axially-impacting pipe sections with outer diameters equal to the target pipe diameter. Laterally-impacting pipe missiles were unable to cause perforation of the target or initiate fracture in the target pipe wall even when the target-pipe section collapsed completely. However, these tests indicated that the global response of the impacted pipe could transmit very large forces to the supporting structure.

22085 **(AEEW-R—2262) Effect of the '1986' WIMS library on the analysis of benchmark lattice experiments.** Halsall, M.J. (UKAEA Atomic Energy Establishment, Winfrith (UK). Reactor Physics Div.). Aug 1987. 18p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705610/JAW.

The 1986 release of the nuclear data library for the WIMS package of lattice codes contains a number of improvements over earlier releases. These include adjusted U-238 resonance integrals, reduced fission product cross section and more recent evaluations of several of the higher actinides. This report looks at the implications of these data changes on the analysis of several 'benchmark' systems, mainly zero energy critical lattice experiments. The new library appears to be well optimised for a wide range of thermal systems, and has been shown to give good results for commercial reactor analysis. However there is scope for improvement, and the conclusions identify a number of appropriate areas for further work.

22086 **(CLM-R—287) TRANC: a modification to CORCON MOD2 for modelling transient thermal conduction in the concrete basemat of a reactor.** Brealey, N.J. (UKAEA Culham Lab., Abingdon). Sep 1988. 32p. H.M. Stationery Office, London, price Pound 10.00.

CORCON MOD2 uses a quasi-steady-state model for ablation in the concrete basemat. TRANC is a modification for CORCON MOD2 which uses a thermal penetration approach to

model transient thermal conduction in the basemat. It also provides an interface for linking to more sophisticated models for the concrete. Example calculations are presented. The TRANC modification has been applied to CORCON 2.04.00. The new version is called CORCON 2.04.TRANC.

22087 **(CONF-890373—3-Vugraphs) Status of motor operated valves aging assessment.** Eissenberg, D.M. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008720/JAW.

From NPAR review group meeting; Rockville, MD, USA (21 Mar 1989).

Motor operated valves (MOVs) have a long history of operational problems in nuclear power plants. Resolution of MOV problems in the past has tended to focus on symptoms rather than root cause. Although there has been more attention focused recently on identifying root causes, problems with valve operational readiness resulting from aging and service wear still persist. In addition, weaknesses in the currently used design equations for sizing of MOVs, identified in tests carried out by industry and confirmed in the recent NRC gate valve blowdown testing, have re-enforced the need for improved in-situ methods for determining the operational readiness of MOVs, whether from aging and service wear or from improper installation and maintenance. The objective of the MOV aging assessment is to evaluate and recommend practical methods for insuring operational readiness of safety-related MOVs under all anticipated operating conditions.

22088 **(CONF-890373—4-Vugraphs) Nonintrusive methods for monitoring the operational readiness of solenoid-operated valves.** Kryter, R.C. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008732/JAW.

From NPAR review group meeting; Rockville, MD, USA (21 Mar 1989).

Solenoid-operated valves (SOVs) are being studied at Oak Ridge National Laboratory as part of the USNRC Nuclear Plant Aging Research (NPAR) Program. The primary objective of the study is to identify, evaluate, and recommend methods for inspection, surveillance, monitoring, and maintenance of SOVs that can ensure their operational readiness--that is, their ability to perform required safety functions under all anticipated operating conditions. An earlier (Phase I) study described SOV failure modes and causes and identified measurable parameters that might be used to monitor the various degradations that lead to functional failure. The present (Phase II) study focuses on devising and then demonstrating the effectiveness of techniques and/or equipment with which to measure the previously identified performance parameters (or others) and thus detect and trend the progress of any degradation that may be occurring. 1 ref., 3 figs.

22089 **(CONF-890373—5-Vugraphs) Aging and service wear of auxiliary feedwater pumps for PWR nuclear power plants.** Greenstreet, W.L. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009109/JAW.

From NPAR review group meeting; Rockville, MD, USA (21 Mar 1989).

This paper describes investigations on auxiliary feedwater pumps being done under the Nuclear Plant Aging Research (NPAR) Program. Objectives of these studies are: to identify and evaluate practical, cost-effective methods for detecting, monitoring, and assessing the severity of time-dependent degradation (aging and service wear); recommend inspection and maintenance practices; establish acceptance criteria; and help facilitate use of the results. Emphasis is given to identifying and assessing methods for detecting failure in the incipient stage and to developing degradation trends to allow timely maintenance, repair or replacement actions. 3 refs.

22090 **(DP-MS—88-211) Steam drum cracking: A case history.** Vormelker, P.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1988. Contract AC09-76SR00001. 9p. (CONF-890437—3). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89002309/JAW.

From Corrosion '89; New Orleans, LA, USA (17 Apr 1989).

Stress corrosion cracking of boiler components is a well known phenomenon and is easily controlled by the use of proper water chemistry during boiler operation. Occasionally water chemistry can go astray and stress corrosion cracking can occur. This paper describes a steam drum cracking incident which transpired in a coal-fired boiler at the Savannah River Plant, Aiken, South Carolina. Metallurgical analysis, in-situ testing results, and water chemistry analyses are discussed in this paper. 3 refs., 4 figs., 1 tab.

22091 **(EPRI-NP—6259-M) Concrete containment tests, Phase 3: Structural elements with penetration sleeves: Final report.** Hanson, N.W.; Roller, J.J.; Schultz, D.M.; Azizinamini, A. (Electric Power Research Inst., Palo Alto, CA (USA); Construction Technology Labs., Skokie, IL (USA)). Mar 1989. 76p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

The tests described in this report are part of Phase 3 of the Electric Power Research Institute (EPRI) program. The overall objective of the EPRI program is to provide a test-verified analytical method of estimating capacities of concrete reactor containment buildings under internal overpressurization from postulated degraded core accidents. Results presented include observed behavior and extensive measurements of deformations and strains as a function of applied load. The data are being used to confirm analytical models for predicting strength and deformation of containment structures in a separate parallel analytical investigation sponsored by EPRI. 11 refs., 31 figs., 2 tabs.

22092 **(EPRI-NP—6261) Analysis of the Sandia one-sixth-scale reinforced concrete containment model: Interim report.** Dameron, R.A.; Dunham, R.S.; Rashid, Y.R.; Sullaway, M.F. (Electric Power Research Inst., Palo Alto, CA (USA); ANATECH Research Corp., La Jolla, CA (USA)). Mar 1989. 228p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report describes part of Phase 3 of the project "Methods for Ultimate Load Analysis of Concrete Containments." As part of the overall objectives to develop a qualified analysis methodology for concrete containment structures, this phase of the research utilizes analytical techniques which have been developed and verified in Phases 1 and 2 to perform comprehensive detailed analyses of the Sandia 1:6 scale reinforced containment model. The EPRI-sponsored finite element code, ABAQUS-EPGEN, and the concrete constitutive model developed previously are the analysis tools used in this research. A comprehensive set of a pre-test predictions were developed in 1986 and 1987 including a series of 2D analyses to identify critical regions, and a number of 3D local analyses to characterize 3D response components. These predictions were compiled and reported to EPRI prior to the test but have remained unpublished until their inclusion in the current report. This material is included here as an Appendix; the predictions based on this work successfully predicted the leakage pressure and many of the liner tearing locations that occurred in the test. The main report compares the pretest calculations to the test results, and it describes several post-test analyses, including axisymmetric analyses to investigate basemat uplift behavior, and the effect of changing concrete tensile strength and a 3D local analysis that studies the behavior at the largest liner tear that occurred. Conclusions of the paper access the analytical methodology in light of the test results. 20 refs., 59 figs.

22093 **(INIS-BR—1431) Measurements of conversion factor of the Argonauta reactor.** Souza, M.I.S. (Instituto de Engenharia Nuclear, Rio de Janeiro, RJ (Brazil)). [1988]. 3p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705754/JAW.

The conversion factor (Fc) in the Argonauta reactor using uranium target prepared by electrodeposition method, irradiated in

the core and in thermal collumn with thermal neutrons flux maximum is studied. Some data obtained through γ radiation emited by U-239 are shown. (M.J.C.).

22094 **(INIS-mf—11914) Isotropic and anisotropic creep characteristics of thick-walled pressure vessels under elastic/plastic stress.** Knoerzer, D. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 27 Aug 1985. 137p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88757364/JAW.

By using the theory of finite deformations the isochoric creep behaviour of thick-walled high-pressure containers (multilayer containers) which have been deformed elastoplastically at the beginning of creep due to internal and external pressure is described. With the example of ball and cylinder stress fields, creep elongations and theoretical failure times are calculated. The consideration of the third deviator invariant leads to a change in the failure time. The creep behaviour of ductile materials is accompanied by the brittle behaviour for the two-layer cylinder.

22095 **(NUREG/CR—5326) Fracture evaluation of surface cracks embedded in reactor vessel cladding.** McCabe, D.E. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Materials Engineering Associates, Inc., Lanham, MD (USA)). Mar 1989. 33p. (MEA—2329). NTIS, PC A03/MF A01 - GPO - OSTI. Order Number TI89009128/JAW.

The surface crack embedded in the clad layer of a reactor pressure vessel (RPV) has been identified as a critical safety assessment condition relative to the pressurized thermal shock accident scenario. This project was initiated to determine the severity of such cracks experimentally. It is the first study to investigate irradiated, clad vessel steel, and to identify the material property and stress conditions in the local region of the crack that are significant to the analysis. Bend bar tests provided the experimental simulation of the subject RPV surface crack. This report covers analysis techniques used and presents the findings indicated by the experimental results for irradiated and unirradiated materials. 13 refs., 13 figs., 2 tabs.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 22470, 22494

22096 **(JAERI-M—88-219) Post irradiation examinations of uranium-plutonium mixed carbide fuels irradiated at low linear power rate.** Maeda, Atsushi; Sasayama, Tatsuo; Iwai, Takashi; Aizawa, Sakuei; Ohwada, Isao; Aizawa, Masao; Ohmichi, Toshihiko; Handa, Muneo. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Nov 1988. 122p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88757256/JAW.

Two pins containing uranium-plutonium carbide fuels which are different in stoichiometry, i.e. (U,Pu)C/sub 1.0/ and (U,Pu)C/sub 1.1/, were constructed into a capsule, ICF-37H, and were irradiated in JRR-2 up to 1.0 at % burnup at the linear heat rate of 420 W/cm. After being cooled for about one year, the irradiated capsule was transferred to the Reactor Fuel Examination Facility where the non-destructive examinations of the fuel pins in the β-γ cells and the destructive ones in two α-γ inert gas atmosphere cells were carried out. The release rates of fission gas were low enough, 0.44 % from (U,Pu)C/sub 1.0/ fuel pin and 0.09% from (U,Pu)C/sub 1.1/ fuel pin, which is reasonable because of the low central temperature of fuel pellets, about 1000 deg C and is estimated that the release is mainly governed by recoil and knock-out mechanisms. Volume swelling of the fuels was observed to be in the range of 1.3 {similar←to} 1.6 % for carbide fuels below 1000 deg C. Respective open porosities of (U,Pu)C/sub 1.0/ and (U,Pu)C/sub 1.1/ fuel were 1.3 % and 0.45 %, being in accordance with the release behavior of fission gas. Metallographic observation of the radial sections of pellets showed the increase of pore size and crystal grain size in the center and middle region of (U,Pu)C/sub 1.0/ pellets. The chemical interaction between fuel pellets and claddings in the carbide fuels is the penetration of carbon in the fuels to stainless steel tubes. The depth of corrosion layer in inner sides of cladding tubes ranged 10 {similar←to} 15 μm in the (U,Pu)C/sub 1.0/ fuel and 15 approx 25 μm in the (U,Pu)C/sub 1.1/ fuel, which is correlative with the carbon potential of fuels posibly affecting the amount of carbon penetration.

22097 **(ORNL/tr—89/16) Fuel rod for nuclear reactor.** Junkrans, S.; Vesterlund, G. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. Translation of Swedish Patent No. Utlaeggningsskrift 7501252-6. 3p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008681/JAW.

It has been determined in many foreign, commercial, and experimental reactors that damage can occur in the fuel in the case of rapid transients. The phenomenon is considered to be the interaction between uranium oxide pellets and the fuel element cladding. This document describes a fuel rod containing a cladding tube that is filled with UO_2 fuel and which also contains a space for fission gas.

22098 **Current- and potential-pulse plating of uranium from fused chlorides.** Marshall, S.L.; Vissers, D.R. (Chemical Technology Div., Argonne National Lab., 9700 South Cass Avenue, Argonne, IL (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

Existing work on the electrodeposition of U metal from fused chlorides has noted a strong tendency toward dendrite formation. Recently, the authors showed that dendrite formation may be avoided by application of short potential pulses (cathodic to the U reference electrode) separated by rest periods at zero potential. This paper describes the application of this technique to the plating of U onto metal coupons of area A = approximately 6 cm/sup 2/, and some additional results that the authors have obtained using their bipolar current-pulse plating.

2204 Control Systems

REFER ALSO TO CITATION(S) 22672

22099 **(FEI—1883) Calculation of the heterogeneity factor for a system of control rods in the model of fast power reactor using the characteristics method.** Suslov, I.R.; Evdokimov, V.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1988. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706147/JAW.

The results of numerical experiments on calculation of the heterogeneity factor for a control system of a fast power reactor are described. The MCCG program permitting to solve the transport equation in two-dimensional plane geometry with irregular lay-out of calculational cells is used for calculations. Effect of the number of space and angular grid nodes on the error of calculated functionals is estimated. The effective process of internal iteration acceleration is given. 7 refs.; 3 figs.; 8 tabs.

22100 **(WHC-SA—0459) Effective transition from panel board to CRT-based process control.** Mayfield, N.E.; Baynes, P.A. (Westinghouse Hanford Co., Richland, WA (USA)). Jan 1989. Contract AC06-87RL10930. 14p. (CONF-890470—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008707/JAW.

From 8. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (23 Apr 1989).

Nuclear process operators have controlled process operations using Panel-Board Mounted Instrumentation at Hanford since 1943. The decision was made to upgrade the B Plant Defense Waste Processing facility to state-of-the-art CRT-based process control, commonly referred to as a Distributive Control System to improve operations safety, plant efficiency, and product quality. The safe and effective transition from PBMI to a DCS was the

result of a cooperative effort between engineering, operations, and training, with full plant management support. Many elements of the upgrade had to be addressed: operator apprehension, vendor courses for the instructor and engineers, training interface with engineering and procurement, closed-loop communications, and structured implementation. Plant management considers this project a model example of effective implementation of new technology. This was a proactive and cooperative approach on a major facility upgrade. All too often training is left out of the planning stages on such projects. This more often than not creates reactive and unproductive training responses because of a lack of technical expertise and program development time. Other nuclear processing facilities are or will be facing this challenge. This paper presents the challenges and successes encountered during the transition to CRT-based process control. The intent of this presentation is to better prepare other training organizations for this type of transition. 2 figs.

22101 **Out-of-core fuel cycle optimization for nonequilibrium cycles.** Comes, S.A.; Turinsky, P.J. (North Carolina State Univ., Electric Power Research Center, Dept. of Nuclear Engineering, P.O. Box 7909, Raleigh, NC (US)). *Nuclear Technology;* **83**: No. 1, 31-48(Oct 1988).

A methodology has been developed for determining the family of near-optimum fuel management schemes that minimize the levelized fuel cycle costs of a light water reactor over a multicycle planning horizon. Feed batch enrichments and sizes, burned batches to reinsert, and burnable poison loadings are determined for each cycle in the planning horizon. Flexibility in the methodology includes the capability to assess the economic benefits of various partially burned bath reload strategies as well as the effects of using split feed enrichments and enrichment palettes. Constraint limitations are imposed on feed enrichments, discharge burnups, moderator temperature coefficient, and cycle energy requirements.

22102 **Generalized control system modeling for liquid-metal reactors.** Vilim, R.B.; Wei, T.Y.C.; Dunn, F.E. (Argonne National Lab., 9700 S. Cass Avenue, Argonne, IL (US)). *Nuclear Science and Engineering;* **99**: No. 3, 183-196(Jul 1988).

A generalized control system modeling capability has been developed for the SASSYS-1 liquid-metal reactor (LMR) system code, significantly extending the simulation capabilities for LMR systems. An important element is the identification of a general equation form that encompasses all control equations encountered in practical applications. The modeling capability is based on steady-state and transient solution techniques suited to the characteristics of this form. As for the user, his control equations are entered in block diagram form as a collection of individual dynamic, function, logic, and table blocks. Constructing plant control equations in this manner is analogous to setting up an analog computer for simulation. The capability is thus sufficiently general for use in modeling a wide variety of control systems and protection systems.

22103 **Combined Monte Carlo narrow resonance - intermediate resonance method for testing resonance integral calculations in complex geometries.** Chen, I.J.; Gelbard, E.M. (National Tsing-Hua Univ., Dept. of Nuclear Engineering, Hsin-Chu (TW); Argonne National Lab., Applied Physics Div., 9700 South Cass Ave., Argonne, IL (US)). *Nuclear Science and Engineering;* **99**: No. 3, 208-231(Jul 1988).

The narrow resonance (NR) approximation has, in the past, been applied to regular lattices with fairly simple unit cells. Attempts to use the NR approximation to deal with fine details of the lattice structure, or with complicated lattice cells, have generally been based on assumptions and approximations that are rather difficult to evaluate. A benchmark method is developed in which slowing down is still treated in the NR approximation, but spatial neutron transport is handled by Monte Carlo. This benchmark method is used to evaluate older methods for analyzing the double-heterogeneity effect in fast reactors, and for computing resonance integrals in the PROTEUS lattices. New methods for treating the PROTEUS lattices are proposed.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 21833, 22058, 22063, 22064, 22065, 22068, 22156, 22192, 22196, 22197, 22207, 22213, 22219, 22232, 22299, 23079, 23102, 23248, 23249

22104 **(BARC—1428) External radiation monitoring in TAPS environs using TLDs (1982-1987).** Basu, A.S.; Bhat, I.S.; Venkatesan, S.; Nambi, K.S.V. (Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1988. 34p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706141/JAW.

This report presents results of environmental monitoring of the Tarapur Atomic Power Station complex for the six year period 1982-87. The salient results are: (1) The distribution of quarterly rate of exposure in most of the places is unimodal on a lognormal plot, (2) The data agree within one standard deviation with the data presented for earlier periods, and (3) The nuclear facility related increases in the environmental radiation levels can be seen at few locations within the exclusion zone. (author). 8 refs., 6 tables, 8 figs.

22105 **(CONF-890218—4) PRISM [Power Reactor Inherently Safe Module] design concept enhances waste management.** Thompson, M.L.; Berglund, R.C. (General Electric Co., San Jose, CA (USA). Advanced Nuclear Technology). 1989. Contract AC03-85NE37937. 20p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008047/JAW.

From 16. annual WATTec conference and exhibition; Knoxville, TN, USA (14 Feb 1989).

PRISM, a modular advanced liquid metal reactor (ALMR), has been designed conceptually by GE under the US Department of Energy sponsorship. The concept design and analyses have been primarily focused on passive safety and improved construction and operating costs. Significantly, the unique design of multiple modules and features of PRISM enhance waste management over conventional reactor systems. This paper provides an overview of PRISM of these enhancements. Inherent to the ALMR's, the sodium coolant precludes crud buildup on reactor surfaces and in components and waste for disposal. Preliminary evaluations indicate this fundamental feature results in factors of 2-4 less waste volume and 2-3 orders of magnitude less curies per megawatt-electric for ultimate disposal. For example, the tap designed for sodium cleanup is expected to be exchanged only once every thirty years. Also, inherent to ALMR's, burning waste actinides and selected fission products to preclude their accumulation and burial is very attractive. The hard neutron spectrum of ALMR burns the actinides efficiently and is not poisoned by the actinides and fission products. The modular design of PRISM components (and the fuel cycle equipment) permit replacement without expensive and potentially hazardous volume reduction. For example, the functional components of the reference electromagnetic pump and IHK can be removed intact for waste disposal. Although development of the reference metal fuel is not completed, it is estimated that (low-level) waste from recycle of the fuel will result in significantly less volume than would be generated by aqueous recycle of oxide fuel. 6 refs., 10 figs.

22106 **(INIS-mf—11390) Nuclear power plants and their environmental impact. A research for the effects on the environment of a normal operating nuclear power plant of the pressurized water reactor type.** Geurts, J. (Technische Hogeschool Eindhoven (Netherlands). Afdeling Technische Natuurkunde). Feb 1986. 67p. (In Dutch). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88706088/JAW.

Methods are considered which are used in the estimation of the amount of radioactivity in the environment of a nuclear power plant caused by a gaseous discharge. It is outlined globally how data are used and which assumptions are made. Much attention is devoted to the gaussian plume model, a description of the spread of smoke gases into the atmosphere. According to this model the concentration is a function of the distance with respect to the source, the chimney and some parameters, like the velocity of the gas

cloud and the standard deviations in the direction perpendicular to the movement of the gas cloud. For the values of these parameters various results from literature are compared and an estimation has been made. For the relative error in the concentration this holds to be equal to the sum of the relative errors in the aforementioned parameters. Apart from the description of waste currents, the dose-response relations for low ionizing radiation doses and a discussion about the source term, a crude estimation has been made of the dose for an individual at a distance of about 10 km of a normal nuclear power plant in operation in the Netherlands. Therewith it is assumed that his food predominantly originates from the surroundings. This estimation yields a value of 50+-25 mREM a year when the power plant discharges the maximum allowed quantity of radioactive waste. Following various publications nuclear power plants discharge only a few percent of the allowed quantity. 15 refs.; 13 figs.; 27 schemes; 21 tabs.

22107 **(INIS-mf—11399) Evaluation pkb-participation procedure location sites nuclear power plants. CPI-cahier-12.** (Raad van Advies voor de Ruimtelijke Ordening, The Hague (Netherlands)). Apr 1986. 72p. (In Dutch). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88706175/JAW.

The participation procedure with regard to the planologic decision (pbk) about location sites for nuclear power plants is considered. The facts about the pkb location sites are described. 4 refs.; 13 figs.; 2 tabs.

22108 **(JINR—R-12-88-279) Experiments to isolate a spontaneously fissionable nuclide from the hot brines of the Cheleken peninsula.** Flerov, G.N.; Dmitriev, S.N.; Azarov, V.A. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1988. 43p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705838/JAW.

By using methods of chemical enrichment (coprecipitation, cementation, sorption, extraction, etc) the isolation of trace elements from the hot brines of the Cheleken peninsula was carried out. Some 10-15 m/sup 3/ of brine were processed in a single experiment. The trace element concentration factor reached the value 10/sup 3/-10/sup 5/. The samples obtained were studied using a neutron /sup 3/He-counter detector. No spontaneously fissioble nuclide (SFN) was revealed in the samples at a detection limit of 10/sup -13/ g/g. The possible explanations of that are discussed. On the basis of the spectral study of the chemical forms of the trace elements the possible analogues of the superheavy elements, in hot brines and from the analysis of the results of the present and previous searches for SFN in Cheleken hot brines an assumption has been advanced that in the brines in compounds with organic admixtures as gold and mercury are . Perspectives of further work aimed at detecting SFN in Cheleken hot brines are discussed. 43 refs.; 2 figs.; 8 tabs.

22109 **(NAGRA-NTB—87-13) Grimsel test site. Analysis of radar measurements performed at the Grimsel rock laboratory in October 1985.** Falk, L.; Magnusson, K.A.; Olsson, O.; Ammann, M.; Keusen, H.R.; Sattel, G. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Feb 1988. 101p. Nagra, CH-5401 Baden, Switzerland.

In October 1985 Swedish Geological Co. conducted a radar reflection survey at Grimsel Test Site to map discontinuities in the rock mass of the Underground Seismic (US) test field. These measurements first designed as a test of the equipment at that specific site allowed a comprehensive interpretation of the geometrical structure of the test field. The geological interpretation of the radar reflectors observed is discussed and a possible way is shown to construct a geological model of a site using the combination of radar results and geological information. Additionally to these results the report describes the radar equipment and the theoretical background for the analysis of the data. The main geological features in the area under investigation, situated in the 'Zentraler Aaregranit', are lamprophyre dykes and fracture/shear zones. Their position and strike have been determined using single- and crosshole radar data, SABIS data (accoustic televiewer) as well as existing geological information from the boreholes or the drifts under the assumption of steep dipping elements (70 to 90/sup o/). (author) 10 refs., 32 figs., 17 tabs.

22110 **(NAGRA-NTB—88-05) Altitude variations in northern Switzerland and southern Black Forest up to the Lake of Constance.** Maelzer, A.; Roesch, H.; Misselwitz, I.; Ebert, M.; Moosmann, D. (Karlsruhe Univ. (T.H.) (Germany, F.R.)). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). May 1988. 81p. (In German). Nagra, CH-5401 Baden, Switzerland.

In 1984, the Federal Office of Topography made a thorough analysis of the levellings in northern Switzerland. With the present study, the area is extended to the southern Black Forest and to the Lake of Constance. All detectable vertical control points are evaluated geologically. The whole Swiss - Baden-Wuerttemberg net consists of 564 points, 140 of which are chosen as representative points. The movement rates of these points are stated in relation to the reference point Laufenburg 177, which is situated in gneiss. Mostly, the movement rates are statistically not significant, but they hint at tendencies. In relation to the 'Hochrhein' the height changes hint at uplifts of about 0.3 mm/year in the Black Forest (Hoellental). Between Neustadt and Waldshut there are relatively subsiding tendencies up to 0.3 mm/year. The area Donaueschingen-Tuttlingen-Stockach is characterized by subsidences (>0.5 mm/year), which turn into an uplift tendency of 0.2 mm/year near the Lake of Constance. (author) 19 refs., 4 figs., 10 tabs.

22111 **(NAGRA-NTB—88-06) Rock laboratory Grimsel. Seismic velocity tomography.** Gelbke, C. (WBK, Westfaelische Berggewerkschaftskasse (Germany, F.R.)). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jun 1988. 176p. (In German). Nagra, CH-5401 Baden, Switzerland.

During the period of July to October 1985 the Institute of Geophysics of the Westfaelische Berggewerkschaftskasse (WBK-IGL) conducted a seismic field experiment at Grimsel Test Site in Switzerland. The areas of investigation are located between the laboratory tunnel and the subhorizontal 150 m long boreholes BOUS 85.001, BOUS 85.002 and BOUS 85.003 (field 1-3) and between the laboratory tunnel and the surface on the Juchlistock (field 4). Traveltimes and amplitude data from the direct p-waves were used to calculate tomograms of the site, which contain the 2-dimensional distribution of seismic velocity respectively attenuation. Tomograms of velocities can be used to distinguish between fractured and intact rock masses. Initially, part of the disturbed zones (i.e. areas of induced fracturing) were already known from geological characterization studies. Velocity profiles calculated from sonic borehole measurements agree extremely well with velocities determined from tomograms in the vicinity of the boreholes. The average discrepancy between the two independent data sets is 1 %, which corroborates the reliability of tomographic inversion. According to an anisotropic velocity distribution of the rock with maximum velocities in NE-SW direction (50/sup o/ +- 5/sup o/), a correction had to be applied to data prior to inversion. The magnitude of this anisotropy, which was also demonstrated in core samples in the laboratory, is approximately +- 1 %. Tomograms calculated for attenuation still show the effects of systematic errors (technical problems). Only very pronounced fracture zones can be detected from these tomograms. The following report includes the technical documentation of the experiment and the numerical inversion of the data. A more detailed presentation of the layout, completion and rating of the experiment as well as the field preparation will be given in a separate report. (author) 18 refs., 85 figs., 1 tab.

22112 **(NUREG/CR—5224) The leachability of decontamination ion-exchange resins solidified in cement at operating nuclear power plants.** McIsaac, C.V.; Mandler, J.W. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1989. Contract AC07-76ID01570. 193p. (EGG—2549). NTIS, PC A09/MF A01 - GPO - OSTI. Order Number TI89009371/JAW.

Data are presented on the release of radionuclides, stable metals, and organic reagents from decontamination ion-exchange

resin wastes solidified in Portland cement. Both solidified and unsolidified decontamination resin waste samples were collected from five commercial light water reactors following chemical decontaminations of primary coolant systems. The decontaminations were performed using the Can-Decon, AP/Citrox, Dow NS-1, and LOMI processes. Samples of unsolidified decontamination resin waste were analyzed for concentrations of 10 CFR Part 61 radionuclides, selected transition metals, and organic chelating and complexing agents. The organic acids included oxalic acid, citric acid, formic acid, picolinic acid, ethylenediaminetetraacetic acid (EDTA), and diethylenetriaminepentaacetic acid (DPTA). Seven solidified resin waste samples were leached in deionized water following the ANS 16.1 leach-test procedure. Releases rates and leachability indexes of radionuclides, transition metals, and organic acids were determined. Analytical methods are described which were used to measure organic acids in resin wastes and in leachate solutions generated during leach-testing of waste form samples. Gas-liquid and ion chromatography methods were developed which allowed detection of organic acids in the tenths-of-a-ppM range. 59 refs., 65 figs., 55 tabs.

22113 **(NWU—1) Tritium and public health. The effects of the tritium contamination of drinking water upon the public health in the Netherlands.** Verburg, B. (Rijksuniversiteit Groningen (Netherlands). Natuurkundig Lab.). Mar 1986. 18p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706120/JAW.

The results are presented of an investigation into the effects of the presence of tritium upon the radiation burden of the people. It is subdivided in three chapters. Ch. 1 presents a draw up of the presence of tritium in the Netherlands, and in particular in the form of tritiated water in the surface and drinking water. Also the impact of new nuclear power stations, for example in Borssele and along the Maas, upon the tritium contents of the surface water is studied. Ch. 2 deals with the standards for exposure of the people and employers to tritium according to the standards of the ICRP for the radiation burden, as interpreted by the Dutch national health council. Ch. 3 discusses recent literature on the dose-response relation of tritium. Special attention is devoted to eventual DNA-damage caused by decay of in-built tritium. 25 refs.; 3 figs.; 3 tabs.

22114 (OEVS-Mitteilung—2/1988, pp 31-53) **Results of extensive environment monitoring of the Austrian Research Centre Seibersdorf.** Sorantin, H.; Irlweck, K.; Steger, F. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Strahlenschutz). 1988. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88706267/JAW. (CONF-8505399—).

From Austrian Radiation Protection Association - spring convention 1985; Vienna, Austria (1 May 1985).

All the methods used for environmental monitoring in the surveillance of the Austrian Research Centre Seibersdorf are described shortly and the values obtained are reported. The results show that neither the research reactor (ASTRA, 8 MW) nor an incineration plant of the waste management department nor the radionuclide laboratories contribute significantly the contamination of the environment. 8 refs., 14 figs., 2 tabs.

22115 **(SPH—07-17) Analysis of the practical consequences of the safeguard policy for the location Moerdijk.** Rijks Planologische Dienst. (Stuurgroep Project Herbezinning, The Hague (Netherlands)). Spr 1988. 28p. (In Dutch). Library, KNAW; Postbus 41950, 1096 DD Amsterdam, Netherlands.

The possible consequences of the policy of safeguards have again been checked on the basis of the expected population development around Moerdijk up to the year 2000, along with an inventory of other relevant developments. Regarding one of the two possible locations of a nuclear power plant on the Moerdijk site, it is concluded that limitations should be imposed on the growth of population in the event of this site being chosen. 9 refs.; 1 figure; 5 tabs.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 22062, 22093, 22736

22116 **(AEEW-R—2294) Reappraisal of experimental relative conversion ratios for early cores in DIMPLE.** Murphy, M.F. (UKAEA Atomic Energy Establishment, Winfrith (UK). Reactor Physics Div.). Nov 1987. 15p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705612/JAW.

Recent measurements of the neutron capture rates in U238 in DIMPLE assemblies have highlighted an error in earlier DIMPLE benchmark data. Although the source of the error was identified many years ago, revised data have never been formally published. To remedy this omission, corrections for the early results have been derived to obtain a recommended set of values. On average the corrected results are (3.3 +- 0.5) % larger than the original values. It is shown that the corrected results are in good agreement with other early measurements, which were rejected at the time, and with those obtained using current techniques.

22117 **(AIAU—87310) Combined wet/dry sipping cell for investigating failed Triga fuel elements.** Boeck, H.; Gallhammer, H.; Hammer, J.; Israr, M. (Atominstitut der Oesterreichischen Universitaeten, Vienna). Aug 1987. 27p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705957/JAW.

A sipping cell to detect failed Triga fuel has been designed and constructed at the Atominstitut. The cell allows both wet- and dry sipping of one single standard triga fuel element. In the dry sipping method the fuel element may be electrically heated up to a maximum temperature of about 300/sup 0/C to allow the detection of temperature dependent fission product release from the fuel element. 20 figs., 1 tab.

22118 **(AIAU—88303) Reinspection plan for the Triga Mark-2 reactor Vienna.** Boeck, H.; Hammer, J.; Zugarek, G. (Atominstitut der Oesterreichischen Universitaeten, Vienna). 1988. 22p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705958/JAW.

A summary is given of the type of inspections, the responsability and the frequency carried out at the Triga Mark 2 reactor Vienna. All safety related systems and components to be inspected are listed. 1 fig.

22119 **(AIAU—88306) Optical inspections of research reactor tanks and tank components.** Boeck, H.; Hammer, J.; Varga, K. (Atominstitut der Oesterreichischen Universitaeten, Vienna; Hungarian Academy of Sciences, Isotope Research Institute, Budapest (Hungary)). (Atominstitut der Oesterreichischen Universitaeten, Vienna). 1988. 17p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705960/JAW.

By the end of 1987 worldwide there were 326 research reactors in operation, 276 of them operating more than 10 years, and 195 of them operating more than 20 years. The majority of these reactors are swimming-pool type or tank type reactors using aluminium as structural material. Although aluminium has prooven its excellent properties for reactor application in primary system, it is however subjected to various types of corrosion if it gets into contact with other materials such as mild steel in the presence of destilled water. This paper describes various methods of research reactor tank inspections, maintenance and repair possibilities. 9 figs.

22120 **(CTA-IEAv-RI—02/86) Effect of /sup 56/Fe resonance scattering in the central flux of ZPR6-7.** Guimaraes, L.N.F.; Menezes, A. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados). Sep 1986. 11p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705619/JAW.

The result obtained in early calculations, where a depletion was observed due to the /sup 56/Fe resonance scattering (28,8 KeV), in the central flux calculated for the ZPR6-7 critical assem-

bly, when the scheme of ETOE-MC**2-UNIMUG calculation is used, and the out of appearance of these depletion, when the scheme of NJOY-ANISIN calculation is used, is explained. (M.C.K.).

22121 **(EGG-NERD—8337) Medical therapy reactor preconceptual design studies.** Lussie, W.G.; Neuman, W.A.; Jones, J.L.; Drexler, R.L.; Lake, J.A.; Griebenow, M.L.; Hobbins, R.R.; deBoisblanc, D.R.; Leyse, C.F. (EG and G Idaho, Inc., Idaho Falls (USA)). Dec 1988. Contract AC07-76ID01570. 141p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009722/JAW.

A pre-conceptual design of a Medical Therapy Reactor Facility to provide Neutron Capture Therapy to cancer patients is described. The facility configuration, neutronic, thermal hydraulic and safety issues are addressed in order to demonstrate that the concept is viable. Based on a preliminary study the cost of the MTR facility is estimated to be about $53.5 million. Estimated construction time is 3 to 5 years. 20 refs., 16 figs., 4 tabs.

22122 **(FEI—1877) Evaluation of β/sub eff/ in fast critical assemblies according to the MCDEN program with the BNAB-78 constants.** Kamaeva, O.B.; Polevoj, V.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706145/JAW.

The error of the value of the effective delayed neutron fraction β/sub eff/ obtained in calculations by the MCDEN program is estimated. The results of calculations for a large number of models of critical assemblies obtained using the MCDEN program and BNAB-78 constants are compared with the results of calculations with other programs and constant collections as well as with experimental data. The conclusion is made on the advisability of reconsidering the delayed neutron total yields accepted in BNAB-78 library for nuclide fast fission. 13 refs.; 7 tabs.

22123 **(ITEF—3(1988)) Trends in development of high-flux research reactors.** Burgov, N.A.; Shvedov, O.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. 24p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706209/JAW.

The designs of research reactors with the thermal neutron flux of 5center dot10/sup 4/-10/sup 16/ neutron/(cm/sup 2/center dots) developed in FRG, USA and Canada are described. The above reactors have reflecting tanks 250-300 cm in diameter filled with D/sub 2/O. The maximum of thermal neutron flux is observed in the reflector at the distance of 20-30 cm from the core. Highly enriched /sup 235/U(45-93%) is used as fuel. The designs envisage the creation of cold neutron sources with neutron-guides, channels for materials irradiation as well as channels for thermal and epithermal neutron extraction. 6 refs.; 10 figs.

22124 **(JAERI-M—88-187) Evaluation of parameters effect on the maximum fuel temperature in the core thermal and hydraulic design of HTTR.** Fujimoto, Nozomu; Maruyama, Soh; Sudo, Yukio; Fujii, Sadao; Niguma, Yoshinori. (Japan Atomic Energy Research Inst., Oarai, Ibaraki. Oarai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Oct 1988. 87p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757245/JAW.

This report presents the results of quantitative evaluation on the effects of the dominant parameters on the maximum fuel temperature in the core thermal hydraulic design of the High Temperature Engineering Test Reactor(HTTR) of 30 MW in thermal power, 950 deg C in reactor outlet coolant temperature and 40 kg/cm/sup 2/ G in coolant pressure. The dominant parameters investigated are (1) Gap conductance. (2) Effect of eccertricity of fuel compacts in graphite sleeve. (3) Effect of spacer ribs on heat transfer coefficients. (4) Contact probability of fuel compact and graphite sleeve. (5) Validity of uniform radial power density in the fuel compacts. (6) Effect of impurity gas on gap conductance. (7) Effect of FP gas on gap conductance. The effects of these items on the maximum fuel temperature were quantitalively identified as hot spot factors. A probability of the appearance of the maximum fuel temperature was also evaluated in this report.

22125 **(JAERI-M—88-210) Distribution of fission products in graphite sleeves and blocks of the ninth and tenth OGL-1 fuel assemblies.** Hayashi, Kimio; Kobayashi, Fumiaki; Minato, Kazuo; Adachi, Mamoru; Fukuda, Kousaku. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Oct 1988. 86p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757251/JAW.

Distribution of fission products in graphite sleeves and blocks of the ninth and tenth OGL-1 fuel assemblies was measured by gamma spectrometry with lathe sectioning. The assemblies were loaded with HTGR fuel compacts, which had been produced by a scaled-up facility for the High Temperature Engineering Test Reactor (HTTR) being developed by JAERI; and they were irradiated in an in-pile gas loop, OGL-1. Fission products detected in the sleeves were /sup 137/Cs, /sup 134/Cs, /sup 155/Eu, /sup 154/Eu, /sup 144/Ce, /sup 125/Sb and /sup 110m/Ag. The last nuclide, however, may have been produced by activation of a stable isotope, /sup 109/Ag, contained as impurity. Effective retention capability of the sleeve was observed for /sup 155/Eu, /sup 154/Eu, /sup 144/Ce and /sup 125/Sb; while, not for /sup 137/Cs and /sup 134/Cs. Concentration of /sup 137/Cs in the graphite blocks was markedly higher at the downstream side than at the upstream side of the coolant. This was ascribed to migration of the nuclide with the coolant flow and its subsequent sorption on the surface of the block.

22126 **(JAERI-M—88-211) Annual report on operation, utilization and technical development of research reactors and hot laboratory, from April 1, 1987 to March 31, 1988.** (Japan Atomic Energy Research Inst., Tokyo). Oct 1988. 178p. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88757252/JAW.

Activities of the Department of Research Reactor Operation in fiscal year 1987 are described. The department is responsible for operation and maintenance of JRR-2, JRR-4, Research Reactor Development Division which performed upgraded JRR-3 and other R D, and Hot Laboratory. In the above connection various other work has also been performed, such as technical management of fuel and coolant, radiation control, irradiation technique, etc. In Hot Laboratory, we have performed post-irradiation examinations of fuels and materials, and also development of examination procedures, too.

22127 **(JAERI-M—88-218) Safety evaluation of the NSRR facility relevant to the modification for improved pulse operation and preirradiated fuel experiments.** Inabe, Teruo; Terakado, Yoshibumi; Tanzawa, Sadamitsu; Katagiri, Hiroshi; Kobayashi, Hideo. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Nov 1988. 133p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88757255/JAW.

The Nuclear Safety Research Reactor (NSRR) is a pulse reactor for the inpile experiments to study the fuel behavior under reactivity initiated accident conditions. The present operation modes of the NSRR consist of the steady state operation up to 300 kW and the natural pulse operation in which a sharp pulsed power is generated from substantially zero power level. In addition to these, two new modes of shaped pulse operation and combined pulse operation will be conducted in the near future as the improved pulse operations. A transient power up to 10 MW will be generated in the shaped pulse operation, and a combination of a transient power up to 10 MW and a sharp pulsed power will be generated in the combined pulse operation. Furthermore, preirradiated fuel rods will be employed in the future experiments whereas the present experiments are confined to the test specimens of unirradiated fuel rods. To provide for these programs, the fundamental design works relevant to the modification of the reactor facility including the reactor instrumentation and control systems and experimental provision

were developed. The reactor safety evaluation is prerequisite for confirming the propriety of the fundamental design of the reactor facility from the safety point of view. The safety evaluation was therefore conducted postulating such events that would bring about abnormal conditions in the reactor facility. As a result of the safety evaluation, it has been confirmed as to the NSRR facility after modification that the anticipated transients, the postulated accidents, the major accident and the hypothetical accident do not result respectively in any serious safety problem and that the fundamental design principles and the reactor siting are adequate and acceptable.

22128 **(JAERI-M—88-225) Plate-out distribution of /sup 137/Cs in the OGL-1 primary loop.** Tsuyuzaki, Noriyoshi; Matsumoto, Mikio. (Japan Atomic Energy Research Inst., Oarai, Ibaraki. Oarai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Nov 1988. 50p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757262/JAW.

In order to reflect on safety evaluation of HTTR (High Temperature Engineering Test Reactor), measurements of fission products plate-out distribution have been done on the primary circuit of OGL-1 (Oarai Gas Loop No.1) which has been operated in the simular gas flow condition with the HTTR. The measurements have been performed since 46th till 73rd operation cycles of the JMTR (Japan Materials Testing Reactor) in which from 3rd to 9th fuel specimens of OGL-1 were irradiated. It became clear that /sup 137/Cs plated-out well on the piping at 400 {similar←to} 500 deg C. It was also observed that /sup 137/Cs released from the pipe at higher than 500 deg C and deposited again on the pipe at lower than 400 deg C when the release rate of /sup 137/Cs from irradiation fuel decreased.

22129 **(JAERI-M—88-227) Fundamental characteristic of V.C.H.P. for JMTR capsule.** Tsuyuzaki, Noriyoshi; Saito, Takashi; Negishi, Kanji. (Japan Atomic Energy Research Inst., Oarai, Ibaraki. Oarai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Nov 1988. 15p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757263/JAW.

When a high dose is required within a short time, irradiation specimens are loaded in a high neutron flux position in the Japan Materials Testing Reactor (JMTR). Consequently, the temperature of the irradiation specimens is increased above 500 deg C by gamma heating. In order to investigate the posibility of low temperature irradiation in high neutron flux position, a capsule equipped with a variable conductance heat pipe (V.C.H.P.) for heat removal and temperature control was tested in out-of-pile condition. This paper reports the results of experiments and analysis on the out-of-pile test of V.C.H.P.. It is clear that the ability of the V.C.H.P. depends on the position of a evaporator part.

22130 **(KAERI/RR—548/86) Study on the development and localization of nuclear fuel technology.** Suk, Ho Chun; Kwack, Eun Ho; Kang, Young Hwan; Jung, Sung Hoon; Kang, Hee Yung; Hwang, Zoo Hwan; Kim, Bong Goo; Ryu, Woo Seog; Kim, Han Soo; Lee, Chung Young. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Dec 1986. 381p. (In Korean). NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS. Order Number DE88705854/JAW.

The KMRR as a special research reactor needs the LEU-dispersion type fuel. The objectives of this research project are to study on the KMRR fuel design and to prepare the domestic design/fabrication proposal of the uranium slicide nuclear fuel as a KMRR fuel. The scopes and contents of this project are as follows: 1. To understand the current development status of LEU fuel and its properties, the physical, chemical mechanical and irradiation behaviors of the plate and rod type LEU fuels were investigated and the current research trends of ANL, NUKEM, JAERI, CEA, CRNL and ORNL were surveyed and reviewed. By the results, silicide LEU fuel was more economical than HEU fuel. And the in-reactor performance of rod type fuel was better than that of plate type fuel. 2. Based on the progress reports of KMRR project, we analyzed the characteristics of KMRR core design with respect to fuel design. From the results of above analysis, the fuel design requirements to be compatible with reactor design were established and described. The fuel design description and basis for KMRR fuel were also established and described by analyzing the data and reports collected for dispersed silicide uranium fuel up to date. 3. Classifying the rod type LEU fuel fabrication procedure into the melting, casting, chipping, hammer milling, extrusion, cladding and welding process, we analyzed and characterized each process. 4. To design the LEU fuel, we reviewed and analyzed the safeties for fuel rods and each component of assembly. 5. The basic study on the welding of Al alloy was performed. 6. To develop the expected necessary technology for the development of KMRR LEU fuel, we surveyed design document the fabrication and inspection equipments and made a domestic fuel design/fabrication proposal for KMRR.

22131 **(KAERI/RR—642/87) Study on the heavy water management and water treatment in KMRR.** Kim, Yong Eak; Sung, Ki Woung; Jung, Jung Won; Chung, Hong Suck; Ahn, Do Hee; Kim, Kwang Rag; Cho, Young Hyun; Park, Seung Woo; Choi, Chang Oong; Kim, Yong Sung and others. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Dec 1987. 115p. (In Korean). NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88706097/JAW.

Heavy water is used as reflector and moderator, while light water as coolant and moderator in the KMRR (Korea Multipurpose Research Reactor). The followings were considered as most important in this study. 1. To keep the heavy water quality at reactor grade by the establishment of its through management technology 2. To design a reflector system properly 3. To manage tritium produced in the KMRR and to minimize its hazards 4. To supply demi-water sufficiently at its best quality.

22132 (KURRI-TR—308, pp 1-15) **Improvement of triple axis neutron diffractometer in the Research Reactor Institute, Kyoto University.** Fukui, S.; Koyano, N.; Achiwa, N.; Mitani, S.; Iwata, Y.; Shibuya, I. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Sep 1988. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780083/JAW. (CONF-8709418—).

From 8. symposium on the development of advanced technology for scientific research; Kumatori, Japan (24 Sep 1987).

The triple axis neutron diffractometer of the Research Reactor Institute (abbreviated as TAS) installed in 1963 has been reformed in the points listed below; (1) The 8008 micro-computer has been replaced with the FACOM U-200 mini-computer. (2) The controlling and measuring systems have been installed in a room constructed outside of the Reactor room. (3) The A.C. servomotors have been replaced by pulse-motors. (4) An absolute type angular detecting system has been replaced to be an incremental one. (5) The soft-ware written in FORTRAN has become to be used. (6) The velocity analysing goniometer has become to be controlled by the computer. Merits of the present refomation are follows; (1) The circumstances for research personals have been considerably improved. (2) The driving speed of each axis has been increased by about four times. (3) The reliability of the diffractometer has been much improved.

22133 **(NUKEM-FuE—88026) Assurance of fabrication technology for MTR fuel elements with low-enriched uranium in a first LEU core of a West German research reactor, project 12. Final report.** Koch, K.H.; Mueller, M. (Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Hanau (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1988. 19p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757379/JAW.

R and D work is reported that accompanied the process engineering work for the fabrication of MTR fuel elements with low U-235 enrichment, results to be used for the design of the series production process. The fabrication of the fuel elements for a first LEU core of the Geesthacht research reactor is the case studied in order to see whether the fabrication process meets the requirements of series production with higher materials throughput, and the quality requirements. The project goals were achieved. The 78 LEU

fuel elements for the research reactor were produced in series without any problem, the fuel elements are up to specifications and meet all requirements. The project work resulted in some process engineering and mechanical improvements, regarding the fabrication of the U/sub 3/Si/sub 2/ pellets and of the fuel powder, standardisation of surface treatment for roll bonding, adjustment of the rolling bonding technique to the conditions of the 'harder' fuel plates, test methods for quality control. All improvements have been worked in into the series production process.

22134 **(NUREG/CR—5328) Correlations between power and test reactor data bases.** Guthrie, G.L.; Simonen, E.P. (ed.). (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Pacific Northwest Lab., Richland, WA (USA)). Feb 1989. Contract AC06-76RL01830. 39p. (PNL—6793). NTIS, PC A03/MF A01 - GPO - OSTI. Order Number TI89008504/JAW.

Differences between power reactor and test reactor data bases have been evaluated. Charpy shift data has been assembled from specimens irradiated in both high-flux test reactors and low-flux power reactors. Preliminary tests for the existence of a bias between test and power reactor data bases indicate a possible bias between the weld data bases. The bias is nonconservative for power predictive purposes, using test reactor data. The lesser shift for test reactor data compared to power reactor data is interpreted primarily in terms of greater point defect recombination for test reactor fluxes compared to power reactor fluxes. The possibility of greater thermal aging effects during lower damage rates is also discussed. 15 refs., 5 figs., 2 tabs.

22135 **(UJV—8402-R-A) Perturbation measurements in reactor LR-0 and their evaluation.** Rypar, W.; Faehrmann, K.H. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia); Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Jul 1988. 24p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706133/JAW.

To investigate space-dependent kinetic effects in reactors of the WWER-1000 type, two central and one eccentric perturbation measurements were performed in the zero power reactor LR-0 of the UJV Rez (CSSR) by trapeze-form movements of an absorber cluster. The measurements were based ona computer aided CAMAC system for the simultaneous data acquisition of 20 spatially distributed neutron detectors and for cluster movement control. The measurements were followed by a detailed evaluation in the ZfK Rossendorf (GDR) with respect to the calculation results of flux response obtained by nodal code HEXDYN3D, the aim of which was to demostrate the limits of the point reactor model and to account for space-dependent effects by approximative methods. A sensitive check of the calculation methods was made possible especially by the eccentric perturbation where the space dependent effects,due to a larger distance of cluster movement, were most significant. (author). 17 figs., 9 refs.

22136 **(UTRCN-G—17) Report of results of joint research using facilities in Japan Atomic Energy Research Institute in fiscal year 1987.** (Tokyo Univ. (Japan). Research Center for Nuclear Science and Technology). Jun 1988. 391p. (In Japanese). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88757288/JAW.

The total themes of the joint research in fiscal year 1987 were 127. These are shown being classified into the general joint research in Tokai and Takasaki, neutron diffraction research and cooperative research. The general joint research is the standard utilization form using research reactors JRR-2 and JRR-4, Co-60 gamma irradiation facilities in Tokai and Takasaki, an electron beam irradiation facility in Takasaki, an electron beam linear accelator and hot laboratories, which are opened for common utilization by Japan Atomic Energy Research Institute. The cooperative research is carried out by concluding research cooperation contracts between the researchers of universities and JAERI. In the general joint research, radioactivation analysis, radiation chemistry, irradiation effect, neutron diffraction and so on are the main themes, and in the cooperative research, reactor technology, reactor materials, nuclear physics measurement and others are the main themes. The total number of visitors was 2629 man-day, and decreased due to the stop of JRR-2. Also other activities are reported. The abstracts of respective reports are collected in this book. (Kako, I.).

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 21747, 22100, 22248, 22249, 22250, 22282

22137 (INIS-SU—75, pp 34-43) **Calculation of radiation-technological parameters of the ABTU facility project.** Glumov, V.P.; Rudoj, V.A.; Breger, A.Kh.; Syrkus, N.P.; Ivanter, E.L. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780081/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Construction and building. Scientific-technical collection.

Results of the development and application of numeric experiment methods for determining radiation-technological parameters of the ABTU facility with uranium irradiation loop, designed for simultaneous heat (electricity) production and modification of long-dimensional polyethylene workpieces are presented. 7 refs.; 5 figs.; 5 tabs.

22138 **(WHC-SA—0358) Analysis of aging effects on active components at the N Reactor.** Zentner, M.D. (Westinghouse Hanford Co., Richland, WA (USA)). Dec 1988. Contract AC06-87RL10930. 9p. (CONF-890405—21). NTIS, PC A02 - OSTI. Order Number DE89008791/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

This paper will describe the aging analysis methodology developed during the N Reactor Level 1 Probabilistic Risk Assessment to help ensure the validity of a plant-specific component failure rate data base. A graphical technique was used on a system-by-system basis, plotting yearly failures, cummulative yearly failures, and the number of failures per hour for each year the reactor operated over a period of 11 years. Linear curve fits were developed for each data set and the trends of these curves were evaluated and compared. Examples of increasing failure rates attributable to aging were discovered, but engineering and maintenance practices at N Reactor have mitigated any potential consequences. 10 figs., 7 tabs.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 21838, 21854, 22015, 22026, 22027, 22028, 22030, 22034, 22039, 22049, 22088, 22089, 22091, 22105, 22112, 22138, 22816, 23218, 23228, 23246, 23247, 23888

22139 **(AEEW-M—2491) Example of the validation of DYNA3D for nuclear plant safety assessment.** Andress, J.C.; Neilson, A.J. (UKAEA Atomic Energy Establishment, Winfrith (UK). Safety and Engineering Science Div.). Sep 1987. 11p. (CONF-8709417—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88705943/JAW.

From DYNA3D user group conference; London, UK (24 Sep 1987).

Although the design of AGR on-load refuelling equipment is such that dropped fuel-assembly faults are virtually incredible in practice, consideration of the safety consequences of such events is necessary. A short programme of drop tests has been conducted by the CEGB to verify computer codes used in the safety assessment. The tests involved dropping solid steel billets onto typical steel standpipes. This paper presents a comparison of experimental results and pre-test DYNA3D predictions carried out at Winfrith, for an experiment in which a 3-d response of the standpipe was generated. The overall response, in terms of standpipe displacements and billet accelerations, was correctly predicted. However, local surface strains on the standpipe were overestimated in some regions as a result of minor inaccuracies in material properties and impact location.

22140 **(AEEW-R—1888) Experimental modelling of core debris dispersion from the vault under a PWR pressure vessel: Part 1. Preliminary experimental results.** Macbeth, R.V.; Trenberth, R. (UKAEA Atomic Energy Establishment, Winfrith (UK). Safety and Engineering Science Div.). Dec 1987. 29p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705947/JAW.

Modelling experiments have been done on a 1/25 scale model in Perspex of the vault under a PWR pressure vessel. Various liquids have been used to simulate molten core debris assumed to have fallen on to the vault floor from a breach at the bottom of the pressure vessel. High pressure air and helium have been used to simulate the discharge of steam and gas from the breach. The dispersion of liquid via the vault access shafts has been measured. Photographs have been taken of fluid flow patterns and velocity profiles have been obtained. The requirements for further experiments are indicated.

22141 **(AEEW-R—2204) Characterisation of vapour-phase alkali metal-tellurium-oxygen species.** Gomme, R.A.; Ogden, J.S.; Bowsher, B.R. (Southampton Univ. (UK); UKAEA Atomic Energy Establishment, Winfrith (UK). Chemistry Div.). (UKAEA Atomic Energy Establishment, Winfrith). Oct 1986. 14p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705949/JAW.

Detailed assessments of hypothetical severe accidents in light water reactors require the identification of the chemical forms of the radionuclides in order to determine their transport characteristics. Caesium and tellurium are important volatile fission products in accident scenarios. This report describes detailed studies to characterise the chemical species that vaporise from heated mixtures of various alkali metal-tellurium-oxygen systems. The molecular species were characterised by a combination of quadrupole mass spectrometry and matrix isolation-infrared spectroscopy undertaken in conjunction with experiments involving oxygen-18 substitution. The resulting spectra were interpreted in terms of a vapour-phase molecule with the stoichiometry M/sub 2/TeO/sub 3/ (M = K,Rb,Cs) for M/Te molecular ratios of {similar←to} 2, and polymeric species for ratios < 2. This work has demonstrated the stability of caesium tellurite. The formation of this relatively low-volatility, water-soluble species could significantly modify the transport and release of caesium and tellurium. The data presented in this report should allow more comprehensive thermodynamic calculations to be undertaken that assist in the quantification of fission product behaviour during severe reactor accidents.

22142 **(AIAU—88304) Soviet power reactors WWER-440, WWER-1000 and LWGR.** Boeck, H. (Atominstitut der Oesterreichischen Universitaeten, Vienna). May 1988. 25p. (In German). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705959/JAW.

A survey is given on the USSR types of power reactors which are the WWER 440, WWER 1000 and the LWGR type reactors. The main technical date are listed. One special chapter deals with the accident in the LWGR reactor Chernobyl. 9 figs., 4 tabs.

22143 **(ANL/PPRNT—89-111) Adaptive contact elements for three-dimensional explicit transient analysis.** Kulak, R.F. (Argonne National Lab., IL (USA)). [1989]. Contract W-31109-ENG-38. 73p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008436/JAW.

A finite element method was developed for treating the mechanics of contact between deformable bodies. The method uses a family of adaptive interface elements, which were based on the penalty method, to handle the changing contact configurations that can occur between discretized contacting bodies. The nodal connectivity of these interface elements was allowed to change during the computations in order to accommodate finite sliding. The infusion of these elements in the interface satisfies the stress equilibrium condition during contact. Explicit forms for the nodal internal forces are presented. The methodology has been coded and several sample problems are presented. 23 refs., 29 figs., 6 tabs.

22144 **(BNL-NUREG—41399) A time-dependent human reliability analysis for a PWR [Pressurized Water Reactor] at shutdown.** Chu, T.L.; Luckas, W.J.; Fitzpatrick, R.G.; Yoon, W.H. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 4p. (CONF-890405—3). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE88013679/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

Pressurized Water Reactors (PWRs) in the USA have experience numerous loss of residual heat removal (RHR) events during reactor shutdown and cooled down conditions. Of particular significance is the loss of the RHR system due to the inadvertent closure of the RHR suction valves on the lowering of the water level in the reactor vessel during required partially drained reactor coolant system (RCS) operations. Brookhaven National Laboratory (BNL) performed an assessment of the core damage frequency (CDF) due to loss of RHR events in an outage. The loss of RHR followed by failure of the operators to respond was found to be the dominant contributor to core damage. The objective of this paper is to present the human reliability model used to assess the associated human error probabilities (HEPs). The model includes determination of the time available for operator action as a function of the time after shutdown, partitioning of the time into a diagnosis phase and a recovery action phase, and assessment of the HEPs. The HEPs were then integrated into the loss of cooling event trees for CDF quantification. 7 refs.

22145 **(BNL-NUREG—41400) PWR [Pressurized Water Reactor] interfacing system LOCAs [loss-of-coolant accidents]: Analysis of risk reduction alternatives.** Bozoki, G.; Kohut, P.; Fitzpatrick, R. (Brookhaven National Lab., Upton, NY (USA)). [1988]. Contract AC02-76CH00016. 5p. (CONF-890405—2). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE88013680/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

This analysis suggests that the most cost-effective method to reduce the risk due to Interfacing System Loss of coolant accidents (ISLs) would be to establish a minimum testing frequency for pressure isolation valves. The suggested minimum frequency would be to perform leak testing of the pressure isolation valves at each refueling and after specific individual valve maintenance. In addition, it would also appear that the tests could be performed during descent from power without significantly increasing the risk of an ISL even and effecting considerable cost savings to the utilities.

22146 **(BNL-NUREG—41418) The Zion integrated safety analysis for NUREG-1150.** Unwin, S.D.; Park, C.K. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 4p. (CONF-890405—5). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE88012891/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

The utility-funded Zion Probabilistic Safety Study provided not only a detailed and thorough assessment of the risk profile of Zion Unit 1, but also presented substantial advancement in the technology of probabilistic risk assessment (PRA). Since performance of that study, modifications of plant hardware, the introduction of new emergency procedures, operational experience gained, information generated by severe accident research programs and further evolution of PRA and uncertainty analysis methods have provided a basis for reevaluation of the Zion risk profile. This reevaluation is discussed in this report. 5 refs.

22147 **(BNL-NUREG—41419) Contain direct containment heating calculations for the Zion plant: A preliminary study.** Tutu, N.; Park, C.; Grimshaw, C.; Ginsberg, T. (Brookhaven National Lab., Upton, NY (USA)). [1988]. Contract AC02-76CH00016. 8p. (CONF-890405—4). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE88012890/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

22148 **(BNL-NUREG—41451) Reevaluation of core damage frequency in light of the occurrence of complex transients at B and W plants.** Youngblood, R.; Hsu, C.J.; Fitzpatrick, R.; Amico, P. (Brookhaven National Lab., Upton, NY (USA)). 1989. Contract AC02-76CH00016. 3p. (CONF-890405—6). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE88013999/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

This paper presents a unified treatment of "complex transients" and core damage events, with the aim of relating the frequencies if the two types of events to each other and to the frequencies of their constituent events. This framework provides a basis for relating the observed frequency of certain transient types to core damage frequency, and deciding whether the occurrence of complex transients means that core damage frequency is higher than it was previously believed to be. 5 refs.

22149 **(BNL-NUREG—42182) Nuclear plant aging study of Residual Heat Removal systems.** Lofaro, R.; Gunther, W.; Subudhi, M.; Taylor, J. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 11p. (CONF-8810155—44). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008162/JAW.

From 16. water reactor safety information meeting; Gaithersburg, MD, USA (24 Oct 1988).

The effects of aging on Residual Heat Removal systems in Boiling Water Reactors have been studied as part of the Nuclear Plant Aging Research program. The aging phenomena has been characterized by analyzing operating experience from various national data bases. In addition, actual plant data was obtained to supplement and validate the data base findings. Time-dependent failure rates were calculated for several components to identify aging trends. A computer program was developed and implemented to model a typical RHR system and perform time-dependent Probabilistic Risk Assessment calculations. Using the time-dependent failure rates calculated from the data, the effects of aging on system unavailability and component importance were investigated. 10 refs., 12 figs.

22150 **(BNL-NUREG—42262) Requantification of the Zion risk profile.** Park, C.K.; Cazzoli, E.; Lee, M.; Grimshaw, C.; Pratt, W.T.; Unwin, S.D. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 18p. (CONF-8810155—45). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008159/JAW.

From 16. water reactor safety information meeting; Gaithersburg, MD, USA (24 Oct 1988).

In February 1987, a preliminary version of the Zion Study performed at the Brookhaven National Laboratory was published for comment. This analysis provided one of the technical bases for the draft NUREG-1150 document. Since the publication, various comments both upon general technical terms and specific calculational issues were received from industry, the public and various peer review panels. In the light of methodological and modelling deficiencies identified in the draft analysis by both internal and external reviews, extensive modifications to the preliminary Zion study were undertaken in support of the final version of NUREG-1150. The integrated analysis of Zion is a collaborative effort involving Brookhaven National Laboratory (BNL) and Idaho National Engineering Laboratories (INEL). The current paper discusses preliminary results of the requantification efforts in various stages of the Zion back-end analysis performed at BNL. 7 refs., 7 figs., 6 tabs.

22151 **(CEA-DAS—535) Safety aspects of nuclear power plant component aging.** Conte, M.; Deletre, G.; Henry, J.Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). 1988. 13p. (CONF-880824—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757340/JAW.

From International nuclear power plant aging symposium; Bethesda, MD, USA (30 Aug 1988).

The safety of nuclear plants depends on the capacity of the systems they are composed of to perform the functions they were designed for. The identification and understanding of phenomena liable to degrade this operational capacity thus constitute one of the safety problems for which allowance must be made at the earliest stage of a project. Aging, a natural and hence unavoidable process affecting all the components of an installation, was identified at a very early stage as being one of these phenomena. The investigation and implementation of solutions to the safety problems associated to aging make it necessary to: defining the domain in which the consequences of aging are to be evaluated, identifying the parameters involved, identifying the components sensitive to these parameters, understanding the mechanisms which govern its evolution. The results of qualification tests, and of tests and checks carried out at different stages of construction and operation, as well as allowance for operating experience, constitute the necessary basis for establishing or improving the regulatory requirements. The procedures for validating components and systems of the installation are also drawn up on the basis of these tests. Finally, the actions initiated within the scope of research and development programmes supply the additional data necessary for such validation, and provide the indispensable support for knowledge improvement.

22152 **(CEA-DAS—544) Use of criteria in the regulatory safety analysis in France.** Queniart, D. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Dec 1988. 11p. (CONF-881106—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757341/JAW.

From International symposium on regulatory practices and safety standards for nuclear power plants; Munich, F.R. Germany (7 Nov 1988).

This paper describes the framework set up in France to allow continuous technical dialogue between operators and safety organizations. The operators, who have primary responsibility for the safety of their installations, propose the measures implemented, or to be implemented, in their installations. Each of these measures is then subjected to a detailed technical examination carried out by the Institute for Nuclear Safety and Protection, without reference to any technical regulations defined a priori. This approach has resulted, particularly in the case of pressurized water reactors (PWRs), in significant progress in the field of safety. This has been achieved by progressively completing the initial approach, derived from American practice for PWR plants, by probabilistic considerations, by a specific approach to severe accidents and by constant use of experience feedback. This last method seems particularly fruitful, and there would appear to be a need also for an indepth study of containment.

22153 **(CEA-DAS—545) Lessons learned from exchanges between the french and german safety authorities. Comparison of the safety levels achieved for reactors built in these two countries.** Droulers, Y.; Wutschig, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete; Technischer Ueberwachungs-Verein Stuggart e.v. (DE)). (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Dec 1988. 8p. (CONF-881106—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757342/JAW.

From International symposium on regulatory practices and safety standards for nuclear power plants; Munich, F.R. Germany (7 Nov 1988).

It is important to emphasize, right at the beginning, the exceptional extent of the assessment work performed over several years on the nuclear power plants in each country (exchange of confidential documents, communication of incidents during the plant building stage, specialist visits to the site, joint reports by the Franco-German Commission on all important safety problems). The D.F.K. (Franco-German Commission) has been the official framework for these exchanges since 1976 (the exchanges relating to FESSENHEIM and its "twin" plant NECKARWESTHEIM 1 began as far back as 1973 and were pursued, when construction of CATTENOM began, by a comparison with PHILIPPSBURG). Apart from its annual plenary session, it presently comprises 6 standing working groups dealing respectively with general safety problems (including primary system technology problems and exchanges on incidents discussed by two subcommittees), emergency plans, radiation protection problems, radioactive waste, fuel cycle installations, fast breeder reactors. It is also worth noting the regu-

lar meetings held by the standing groups of experts (GPR and RSK), which have enabled periodical assessment of the extent to which the approaches of the two countries to the main safety problems are tending to converge (severe accidents, operating feedback, containment, followup on the TMI and CHERNOBYL accidents, etc) and the exchanges between the IPSN and the GRS on the corresponding research programs.

22154 **(CONF-881011—38) Thermal behavior of molten corium during TMI-2 core relocation event.** Anderson, J.L.; Sienicki, J.J. (EG and G Idaho, Inc., Idaho Falls (USA); Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007499/JAW.

From Joint meeting of the European Nuclear Society and the American Nuclear Society; Washington, DC, USA (30 Oct 1988).

During the TMI-2 accident, a pool of molten corium formed in the central region of the core and was contained by solidified crusts. Failure of the crust surrounding the molten material, at approximately 224 min, resulted in a relocation of an estimated 20-25 tons of molten corium through peripheral fuel assemblies in the east side of the vessel, as well as through the core barrel assembly (CBA) at the periphery of the core. This paper presents the results of an analyses carried out to investigate the thermal interactions of molten corium with the CBA structures during the relocation event. The principal objectives of the analyses are: (a) to assess the potential for relocation to take place through the CBA versus the flow of molten core material directly downward through the core via the fuel assemblies; and (b) to understand the distribution of prior molten corium observed during vessel defueling examinations. 5 refs., 1 fig.

22155 **(CONF-890425—1) Considerations in the evaluation of concrete structures for continued service in aged Nuclear Power Plants (NPPs).** Naus, D.; Marchbanks, M.; Oland, B.; Arndt, G.; Brown, T. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 14p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008742/JAW.

From American power conference; Chicago, IL, USA (24 Apr 1989).

Currently, there are {approximately}119 commercial nuclear power plants (NPPs) in the US either under construction, operating at low-to-full power, or awaiting an operating license. Together, these units have a net generating capacity of {approximately}110 GW(e). Assuming no life extension of present facilities, the operating licenses for these plants will start to expire in the middle of the next decade with Yankee Rowe being the first plant to attain this status. Where it is noted that with no life extension of facilities, a potential loss of electrical generating capacity in excess of 75 GW(e) could occur during the time period 2006 to 2020 when the operating licenses of 80 to 90 NPPs are scheduled to expire. A potential timely and cost-effective solution to meeting future electricity demand, which has worked well for non-nuclear generating plants, is to extend the service life (operating licenses) of existing NPPs. Since the concrete components in these plants provide a vital safety function, any continued service considerations must include an in-depth assessment of the safety-related concrete structures. 7 refs.

22156 **(DBW-RIZA—85-016) Possible contamination of the IJsselmeer in case of a calamity in a, along the IJsselmeer located, nuclear power plant of 1000 MWe.** Jagtman, E.; Wit, J.A.W. de. (Rijksinstituut voor Zuivering van Afvalwater, Voorburg (Netherlands); Rijkswaterstaat, Lelystad (Netherlands). Dienst Binnenwateren - Rijksinstituut voor de Zuivering van Afvalwater (RIZA)). 1985. 44p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706143/JAW.

On the basis of new premises, described in the Advice about modified insights with regard to the consequences of severe reactor accidents, published in 1982 by the Dutch commission for nuclear safety, possible effects of a possible accident with a nuclear power plant along the IJsselmeer upon the drinking water function of the IJsselmeer water are reviewed. Starting from an accident of the KM-category in a nuclear power plant of 1000 MWe located along the IJsselmeer the authors have investigated the elapse of concentration of some radionuclides in the IJsselmeer as a function of the radioactive decay and the water refreshment of the lake after the accident and after deposition in the IJsselmeer of radionuclides efflued into the air. Further the radioactivity concentration is compared with standard values based upon the ALI values for ingestion as mentioned in ICRP-30. Starting from these results the time is calculated during which the derived standards will be surpassed. 11 refs.; 31 figs.; 6 tabs.

22157 **(DOE/ET/32043—T26-Vol.1) Final safety analysis report for the Galileo Mission: Volume 1, Reference design document.** (General Electric Co., Philadelphia, PA (USA). Valley Forge Space Center). May 1988. Contract AC01-79ET32043. 176p. NTIS, PC A09 - OSTI. Order Number DE89007268/JAW.

The Galileo mission uses nuclear power sources called Radioisotope Thermoelectric Generators (RTGs) to provide the spacecraft's primary electrical power. Because these generators contain nuclear material, a Safety Analysis Report (SAR) is required. A preliminary SAR and an updated SAR were previously issued that provided an evolving status report on the safety analysis. As a result of the Challenger accident, the launch dates for both Galileo and Ulysses missions were later rescheduled for November 1989 and October 1990, respectively. The decision was made by agreement between the DOE and the NASA to have a revised safety evaluation and report (FSAR) prepared on the basis of these revised vehicle accidents and environments. The results of this latest revised safety evaluation are presented in this document (Galileo FSAR). Volume I, this document, provides the background design information required to understand the analyses presented in Volumes II and III. It contains descriptions of the RTGs, the Galileo spacecraft, the Space Shuttle, the Inertial Upper Stage (IUS), the trajectory and flight characteristics including flight contingency modes, and the launch site. There are two appendices in Volume I which provide detailed material properties for the RTG.

22158 **(DOE/ID—10226) Simulation of the Semiscale MOD-2C small-break loss-of-coolant accident using MAAP-DOE: Task 3.6.10.1.** (Fauske and Associates, Inc., Burr Ridge, IL (USA)). Jan 1989. Contract AC07-76ID01570. 116p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009653/JAW.

The Semiscale S-NH-1 experiment was simulated using the Modular Accident Analysis Program, Version MAAP-DOE. Test S-NH-1 investigated the anticipated pressurized water reactor response to a small-break loss-of-coolant accident without high-pressure injection. Results during the initial 150 seconds generally agree well with the experimental data. Results for the remainder of the simulation are in fairly good agreement, but they are hampered somewhat by the uncertainty in the secondary side leak rate which was present in the experimental apparatus. 14 refs., 7 figs., 9 tabs.

22159 **(DP-MS—88-105) Model of SRP electric power system.** Smith, J.A. (Savannah River Lab., Aiken, SC (USA)). 1989. Contract AC09-76SR00001. 15p. (CONF-890405—20). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007580/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

A model of the principal electric power system at SRP was constructed to estimate unavailability and unreliability of key buses that may be called on under reactor accident conditions. The results are for use in a probabilistic risk analysis. This report is concerned with model characteristics only; the data is treated as incidental. 1 ref., 2 figs., 3 tabs.

22160 **(DPST—87-738) TRAC [Transient Reactor Analysis Code] model of reactor vent paths.** Pevey, R.E.; Reece, J.W. (Savannah River Lab., Aiken, SC (USA)). 18 Dec 1987. Contract AC09-76SR00001. 43p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007948/JAW.

The Safety Methods group of Scientific Computations Division (SCD) is currently calculating assembly power limits based on

reactor response to a double-ended guillotine pipe break loss of coolant accident (LOCA). SCD has implemented a two-level approach in which the Transient Reactor Analysis Code (TRAC) is used to calculate the system pressure response to the LOCA, and these pressures serve as the boundary conditions for a detailed assembly calculation using FLOWTRAN. As part of the TRAC calculation, a detailed TRAC model of the reactor vent paths has been developed that involves the hardware in the top portion of the reactor tank through which air flows as the moderator tank drains following the LOCA initiation. The hardware included in this model are the top shield (with its many penetrations), the gas space above the top shield, the vacuum breakers, the U tube, the helium blanket gas system, and the gas ports. This detailed model is necessary for an accurate calculation of the tank pressures in the first few seconds of the LOCA because the initial tank depressurization is relieved through these vent paths. The tank pressures for about 5 seconds into the transient are sensitive to water flow from the gas space through the top shield, the associated expansion pressure drop of the blanket gas, and the clearing of the vacuum breakers and gas ports. This model was added to a previously developed TRAC model of the rest of the system and the resulting full system model was used to calculate the pressure response during the first few seconds of the LOCA. 8 refs., 8 figs.

22161 **(ECN-PB—87-13) Serious reactor accidents reconsidered. The source term.** (Netherlands Energy Research Foundation, Petten). Dec 1987. 306p. (In Dutch). NTIS (US Sales Only), PC A14/MF A01 - OSTI; INIS. Order Number DE88706144/JAW.

Two parts.

The chance is determined for damage of the reactor core and that sequel events will cause excursion of radioactive materials into the environment. The gravity of such an accident is expressed by the source term. It appears that the chance for such an accident varies with the source term. In general it is valid that how larger the source term how smaller the chance is for it and vice versa. The chance for excursion is related to two complexes of events: serious damage (meltdown) of the reactor core, and the escape of the liberated radionuclides into the environment. The results are an order of magnitude consideration of the relation between the extent of the source term and the chance for it. From the spectrum of possible source terms three representative ones have been chosen: a large, a medium and a relative small source term. This choice is in accordance with international considerations. The hearth of this study is the estimation of the chance for occurrence of the three chosen source terms for new light-water reactors. refs.; figs.; tabs.

22162 **(EGG-M—88262) A comparison of RAM importance measures.** Atwood, C.L.; Wolford, A.J.; Wright, R.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1989. Contract AC07-76ID01570. 6p. (CONF-890405—15). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005287/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

Measures of importance of components and cut sets of a system are reviewed. The measures considered are based on reliability, availability, and maintainability, the three elements of the acronym RAM. They follow the approaches of Fussell and Vesely and of Birnbaum. A new Birnbaum-type unmaintainability importance measure is proposed. The measures are compared in a simple example, and the appropriate use of unmaintainability importance is discussed. 9 refs., 2 tabs.

22163 **(EGG-NERD—8395) Iodine spiking data from commercial PWR operations.** Adams, J.P. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1989. Contract AC07-76ID01570. 54p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009735/JAW.

It is required, by the Nuclear Regulatory Commission (NRC) to determine the response of a pressurized water reactor (PWR) to a steam generator tube rupture (SGTR) as part of the safety analysis for the plant. The SGTR analysis includes assumptions regarding the presence of fission product iodine in the reactor coolant resulting from iodine spikes. Due to uncertainties in the consequences, the NRC has designated this class of accident as a generic safety issue. The results of a previously completed scoping task were extended, resulting in two data bases on iodine spiking. The first is a compilation of the maximum iodine concentration expected in the reactor coolant system (RCS) during an iodine spike. The second, a subset of the first, is a compilation of the expected iodine release rates (from the fuel into the RCS coolant) during an iodine spike. The results of statistical analyses are presented for these two data bases and conclusions are made regarding guidelines for the analysis of SGTRs with iodine spikes. 19 refs., 10 figs., 8 tabs.

22164 **(EPRI-NP—6276) Earthquake experience data on anchored, ground-mounted vertical storage tanks: Final report.** Hashimoto, P.S.; Tiong, L.W. (Electric Power Research Inst., Palo Alto, CA (USA); EQE Engineering, Inc., Costa Mesa, CA (USA)). Mar 1989. 130p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

This research study is an investigation into the use of data on the performance of ground mounted, anchored vertical storage tanks in past earthquakes ("earthquake experience data") to assess the seismic adequacy of essential nuclear plant tanks. The results show that such data are available and are applicable to nuclear plant tanks. Anchored tanks constructed comparable to nuclear plant tanks are capable of surviving earthquakes having ground motions greater than most nuclear plant design bases without a loss of fluid contents. Most nuclear plant tanks should have greater seismic capacities than comparable database tanks. Detailed seismic evaluations of selected database tanks were performed. Analytical methods available for seismic margin evaluation and design appear to be adequately conservative. Best estimate evaluations and sensitivity studies identify potential conservatisms and uncertainties that may require more investigation. 24 refs., 44 figs., 9 tabs.

22165 **(EUR—11408) Joint CEC/OECD(NEA) workshop on recent advances in reactor accident consequence assessment Proceedings of the Second part of the workshop.** Olast, M.; Sinnaeve, J. (eds.). (Commission of the European Communities, Luxembourg). 1988. 464p. (CONF-8801124—). NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW.

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

The workshop on probabilistic accident consequence assessment techniques and their applications aims at a review of the present knowledge of all the work in this field. This includes the atmospheric dispersion and deposition modelling, with comparison of the different approaches, the exposure pathways with emphasis on post-deposition processes, the health effects with emphasis on the consequences of the Hiroshima and Nagasaki data re-evaluation, the countermeasures and their economic consequences, the uncertainty analysis of the models and finally the applications of these models as aids to decision making.

22166 (EUR—11408, pp 3-12) **CEC programme on accident consequence assessment.** Sinnaeve, J.; Olast, M.; Luykx, F. (Commission of the European Communities, Brussels (BE)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

The Commission of the European Communities, in the framework of its Radiation Protection Programme, initiated in 1983 a two-year project on "Methods for Assessing the Radiological Impact of Accidents-MARIA". Major contractors were the Kernforschungszentrum Karlsruhe (KfK-FRG) and the National Radiological Protection Board (NRPB-UK). Within the 1985-1989 Radiation Protection Programme, the MARIA programme was continued and enlarged (MARIA 2) through complementary research contracts in several Member States. At present, 28 projects contribute to the MARIA-2 programme, the priorities of which are shortly presented. In the aftermath of the Chernobyl accident, the priorities of the MARIA-2 programme were evaluated and additional projects were started. A total of ten actions, of which five are directly relevant for the MARIA-2 programme, was launched. These actions are briefly described.

22167 (EUR—11408, pp 13-26) **Nordic safety program on accident consequence assessment.** Tveten, U. (Institute for Energy Technology, Kjeller (NO)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

One important part of Nordic cooperation is partially funded by the Nordic Council of Ministers, namely the work performed within the Nordic Safety Program (often referred to as the NKA projects). NKA is the Nordic abbreviation of the Nordic Liaison Committee on Atomic Energy. One program area in the present four-year period is concerned with problems related to reactor accident consequence assessment, and contains almost twenty projects covering a wide range of subjects. The author is program coordinator for this program area. The program will be completed in 1989. The program was strongly influenced by Chernobyl, and a number of new projects were included in the program in 1986. Involved in the program are these Nordic institutions: Riso National Laboratory (Denmark). Technical Research Centre of Finland. Finnish Centre for Radiation and Nuclear Safety. Finnish Meteorological Institute. Institute for Energy Technology (Norway). Agricultural University of Norway. Meteorological Institute of Norway. Studsvik Energiteknik AB (Sweden). National Defence Research Laboratory (Sweden).

22168 (EUR—11408, pp 27-38) **New program system UFOMOD to assess the consequences of nuclear accidents.** Ehrhardt, J.; Burkart, K.; Hasemann, I.; Matzerath, C.; Panitz, H.J.; Steinhauer, C. (Kernfurchungszentrum Karlsruhe G.m.b.H. (DE). Inst. fuer Neutronenphysik und Reaktortechnik). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

The program system UFOMOD is a completely new accident consequence assessment (ACA) code. Its structure and modelling is based on the experience gained from applications of the old UFOMOD code during and after the German Risk Study - Phase A, the results of scientific investigations performed within both the ongoing Phase B and the CEC-Project MARIA, and the requirements resulting from the extended use of ACAs to help in decision making. One of the most important improvements is the introduction of different trajectory models for describing atmospheric dispersion in the near range and at larger distances. Protective actions and countermeasures modelling takes into account recommendations of international commissions. The dosimetric models contain completely new age-, sex- and time-dependent data of dose-conversion factors for external and internal radiation; the ingestion pathway is modelled to consider seasonal dependencies. New dose-risk-relationships for stochastic and non-stochastic health effects are implemented; a special algorithm developed for ACA codes allows individual and collective leukemia and cancer risks to be presented as a function of time after the accident. According to the modular structure of the new UFOMOD program system, an easy access to parameter values and the results of the various submodels exists what facilitates sensitivity and uncertainty analyses.

22169 (EUR—11408, pp 50-52) **Benchmarking of the MACCS code.** Acharya, S.; Lancaster, L.; Ritchie, L. (USNRC, Washington, DC (US); SNL, Albuquerque, NM (US)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

After publication of the OECD/NEA/CSNI sponsored reactor accident consequence model comparison study in 1983, several participating countries have made substantial changes (improvements) in their consequence assessment models and codes. In the U.S. the Nuclear Regulatory Commission (USNRC) sponsored MELCOR Accident Consequence Code System (MACCS) has been developed by the Sandia National Laboratories (SNL) as the successor to the probabilistic consequence assessment code CRAC2 and has been extensively used in the analyses for the recent NRC publication "Reactor Risk Reference Document", NUREG-1150 draft for public comment. MACCS is also being applied to several regulatory activities, such as preparing technical basis for emergency planning rulemaking, developing procedures for safety goal implementations, etc. Modeling of atmospheric dispersion, deposition, plume rise, emergency response, and radiological dosimetric data, chronic exposure, and health effects in MACCS are different from those of its predecessors (CRAC and CRAC2). Therefore, there is a need to know the differences in the consequence assessments that would be expected to arise purely from the modeling differences. The CSNI benchmark problems 1-7 require a series of calculations designed to allow comparison of individual model components as well as total consequence and risk estimates. The NRC research staff, with assistance from Sandia, has been exercising the MACCS code using the CSNI benchmark problems 1-7 to assess differences between the MACCS predictions and the earlier results. The results of this exercise will be published as a NUREG document. In this paper, the MACCS results obtained to date, namely: the results for problems 1-4, are discussed and contrasted with those in the international code comparison study.

22170 (EUR—11408, pp 55-67) **Puff-trajectory modelling for long-duration releases.** Underwood, B.Y. (UKAEA Safety and Reliability Directorate, Gulcheth). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

This investigation considers some aspects of the interpretation and application of the puff-trajectory technique which is increasingly being considered for use in accident consequence assessment. It firsthigh lights the problems of applying the straight-line Gaussian model to releases of many hours duration and the drawbacks of using the ad hoc technique of multiple straight-line plumes, thereby pointing to the advantages of allowing curved trajectories. A number of fundamental questions are asked about the conventional puff-trajectory approach such as: what is the justification for using ensemble-average spread parameters (σ values) in constructing particular realizations of the concentration field and to what sampling time should these σ values correspond. These questions are answered in the present work by returning to basics: an interpretation of the puff-trajectory method is developed which establishes a correspondence between the omission of wind-field fluctuations with period below a given value in the generation of trajectories and the achievable spatial resolution of the estimates of time-integrated concentration. In application to accident consequence assessment, this focusses attention on what spatial resolution is necessary for particular consequence types or is implicit in the computational discretization employed.

22171 (EUR—11408, pp 68-79) **Importance of trajectory modelling in accident consequence assessments.** Jones, J.A.; Williams, J.A.; Hill, M.D. (National Radiological Protection Board, Chilton (UK)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

Most atmospheric dispersion models used at present or probabilistic risk assessment (PRA) are linear: they take account of the wind speed but not the direction after the first hour. Therefore, the trajectory model is a more realistic description of the cloud's behaviour. However, the extra complexity means that the computing costs increase. This is an important factor for the MARIA code which is intended to be run on computers of varying power. The numbers of early effects predicted by a linear model and a trajectory model in a probabilistic risk assessment were compared to see which model should be preferred. The trajectory model predicted about 25% fewer expected early deaths and 30% more people evacuated than the linear model. However, the trajectory model took about ten times longer to calculate its results. The choice between the two models may depend on the speed of the computer available.

22172 (EUR—11408, pp 80-91) **Importance of long range atmospheric transport in probabilistic accident consequence assessment.** ApSimon, H.M.; Goddard, A.J.H.; Wilson, J.J.N. (Imperial Coll. of Science and Technology, London (UK). Dept. of Mechanical Engineering). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

The disaster at the Chernobyl-4 reactor has demonstrated that severe nuclear accidents can give rise to significant radiological consequences several thousand kilometres from the source. The subsequent dispersion of the release over much of Western Europe further demonstrated the importance of synoptic scale weather patterns in determining the magnitude of the consequences of such accidents. A version of the MESOS-II European scale trajectory model, which is able to simulate large scale variations in weather conditions through the use of spatially and temporally variable meteorological input data, has been used to simulate the pattern of dispersion from Chernobyl with some success. This paper presents the results of probabilistic consequence assessments for a number of West European sites, made using the MESOS-II model. The results illustrate the effects, on probabilistic assessments, of using a more realistic treatment of long range atmospheric transport than the Gaussian plume model and also the spatial variation in the distributions of consequences arising from the variation in synoptic scale weather conditions across Western Europe.

22173 (EUR—11408, pp 92-102) **Improved atmospheric dispersion modelling in the new program system UFOMOD for accident consequence assessments.** Panitz, H.J. (Kernforschungszentrum Karlsruhe G.m.b.H. (DE). Inst. fuer Neutronenphysik und Reaktortechnik). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

An essential aim of the improvements of the new program system UFOMOD for Accident Consequence Assessments (ACAs) was to substitute the straightline Gaussian plume model conventionally used in ACA models by more realistic atmospheric dispersion models. To identify improved models which can be applied in ACA codes and to quantify the implications of different concepts of dispersion modelling on the results of an ACA, probabilistic comparative calculations with different atmospheric dispersion models have been carried out. The study showed that there are trajectory models available which can be applied in ACAs and that these trajectory models provide more realistic results of ACAs than straight-line Gaussian models. This led to a completly novel concept of atmospheric dispersion modelling which distinguish between two different distance ranges of validity: the near range (< 50 km) and the far range (> 50 km). The two ranges are assigned to respective trajectory models.

22174 (EUR—11408, pp 103-113) **Comparison of Gaussian and Lagrangian atmospheric dispersion models with respect to their applicability for the assessment of short-range consequences of accidental releases.** Govaerts, P.; Sohier, A.; Schorling, M. (Centre d'Etude de l'Energie Nucleaire, Mol (BE); Industrieanlagen - Betriebsgesellschaft m.b.H., Ottobrunn (DE)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

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The bigaussian dispersion model is the most commonly used model as well in probabilistic consequence assessments as in real-time evaluations. The basic reasons for this are the limited need of computer time, the fact that the model fits rather well observed data in flat terrain and nominal meteorological conditions, and the lack of data, needed as input by more complicated models. Due to the development of computer capacities, the first argument becomes less important. Lagrangian models have been developed recently, which are able to meet realistic requirements on the point of computer time, and can use some modelling approaches to reduce their need on input data. The comparison of the two approaches is made by analysing the differences between calculated and measured concentrations during 6 tracer experiments. Some experiments were performed in terrain and meteorological conditions for which gaussian models are normally applied without any reservation. The other tests were done in more complex conditions, normally suited for more complex models with a large set of input data. Based on the analysis of the performance of the two models, a picture is given of the boundaries of the applicability of both approaches, and the related efforts is computer time and collection of input data. This study is funded as study contract by the Commission of the European Communities.

22175 (EUR—11408, pp 114-125) **Theoretical investigation of large natural barrier effects on sea breeze and contamination patterns.** Varvayanni, M.; Bartzis, J.G.; Catsaros, N. (National Research Centre for the Physical Sciences Democritos, Athens (GR)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

The degree of contamination of a large population center lying in the proximity of a mountain, is expected to be strongly dependent on the mountain presence due to its significant distortion of the flow fields and diffusion processes. The phenomena become even more complex in the presence of sea breeze occurring in the area during daytime. In accident consequence assessment there is a need to develop suitable analytical tools to be able to predict efficiently and correctly such complex situations. The present work refers to a 1000 m two dimensional mountain range surrounded by sea. The orography under consideration represents an idealized west-east cross section of the Athens basin. The diurnal cycle of the mesoscale circulation developing across the mountainous coastline, as well as the effect on the contamination patterns are studied. The major phenomena occurring are discussed. The exercise is also part of the effort to develop the necessary capability in the ADREA-I code under development in NRCPS "Demokritos" to treat domain of any complexity and any atmospheric stability in atmospheric dispersion analysis and accident consequence assessment in general.

22176 (EUR—11408, pp 126-137) **Effect of particle size on atmospheric dispersion and on radiation doses.** Rossi, J.; Vuori, S. (Valtion Teknillinen Tutkimuskeskus, Helsinki (FI)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

Generally a value of 0.01 m/s for the dry deposition velocity is employed in computer codes. The ARANO computer code has been developed to include a - possibility to consider of four different particle size categories. The four particle size classes considered illustrate deposition velocities of 0.001, 0.01, 0.013 and 0.02 m/s, of which the two last values include the gravitational settling velocities of the particles with 10 and 20 μm diameters (aerodynamical), correspondingly. Further a zero deposition velocity is applied for noble gases and other chemically less active gases. Relative ground level air concentrations at long distance indicate a difference of orders of magnitude at the most between categories in stable condition. The use of the surface depletion approach (K/sub z/-model) amplifies the effects of dry deposition velocity changes as compared to the usual source depletion method. On the basis of different cases studied, a difference of an order of magnitude in individual dose was obtained at the most. The dry deposition values of 0.01 m/s seems to result in an overestimation of the expected early health effects but on the other hand in an underestimation of late health effects compared to the results calculated on the basis of release categorization into different particle size groups.

22177 (EUR—11408, pp 138-150) **Turbulent diffusion modelling for windflow and dispersion analysis.** Bartzis, J.G. (National Research Centre for the Physical Sciences Democritos, Athens (GR)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

The need for simple but reliable models for turbulent diffusion for windflow and atmospheric dispersion analysis is a necessity today if one takes into consideration the relatively high demand in computer time and costs for such an analysis, arising mainly from the often large solution domains needed, the terrain complexity and the transient nature of the phenomena. In the accident consequence assessment often there is a need for a relatively large number of cases to be analysed increasing further the computer time and costs. Within the framework of searching for relatively simple and universal eddy viscosity/diffusivity models, a new three dimensional non isotropic model is proposed applicable to any domain complexity and any atmospheric stability conditions. The model utilizes the transport equation for turbulent kinetic energy but introduces a new approach in effective length scale estimation based on the flow global characteristics and local atmospheric stability. The model is discussed in detail and predictions are given for flow field and boundary layer thickness. The results are compared with experimental data with satisfactory results.

22178 (EUR—11408, pp 151-164) **Long range transport and soil deposition: models and experimental observations in Northern Italian regions as following the Chernobyl nuclear accident.** Facchini, U.; Ravasini, G.; Capra, D.; Bacci, P.; Bonelli, P. (Milan Univ. (IT). Ist. di Fisica Generale Applicata; Centro Ricerche Termiche Nucleari, Milan (IT)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

The meteorological factors that characterized the transport and deposition on the ground of the radionuclides from the Chernobyl nuclear power station over northern Italy in May 1986 are examined. The computation procedures of a comprehensive study of long-range pollution transport problem are developed and the particle trajectories are reconstructed, taking into account the configuration updown-wind the Alps. A number of measurements of the radionuclide density in atmosphere in the first week of May 1986 gives a general uniform value over the Po valley and in the Alpine valleys. The deposition on ground is then calculated by means of dry and wet deposition standard models and taking into account the height of the clouds and the rains data. The fall-out values for Cs/sup 137/ are spread from 7000 Bq/m/sup 2/ up to 100.000 Bq/m/sup 2/; the lower values are observed generally in the places of Veneto and Emilia and correspond to dry deposition in absence of rain. The greater values are observed in the Alpine valleys facing South and in the Lombardy lakes region where the rainfall was particularly intense. The comparison between the model predictions and the observed values of Cesium fall-out gives quite reasonable agreement.

22179 (EUR—11408, pp 165-178) **Distribution on trees of dry deposited material from the Chernobyl accident.** Roed, J. (Riso National Lab., Roskilde (DK)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

The distribution of material from the Chernobyl accident that has been dry deposited on forest trees near Roskilde (Denmark) and on trees in a suburban area of Roskilde are investigated. The dry deposition velocities on the plan-projected area covered by the trees are found and compared with those on paved surfaces. The conclusion is that the deposited material is distributed fairly uniformly on the trees, and that the deposition velocities on trees are more than 10 times higher than on paved surfaces. A bulk deposition constant is defined and proposed to be used for modelling the deposition on trees in an urban environment. This work was supported by the EEC Radiation Protection Programme under contract No. B16-107-DK and by NKA, the Nordic Liaison Committee for Atomic Energy.

22180 (EUR—11408, pp 179-190) **Treatment of wet deposition in probabilistic accident consequence assessment.** Apsimon, H.M.; Simms, K.L.; Stott, P. 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

Chernobyl has emphasized the importance of wet deposition of radionuclides in accident consequence assessment. This is complicated by the highly variable spatial and temporal occurrence of rainfall, with a tendency towards higher levels of contamination over mountains and high land. This paper illustrates the use of detailed precipitation data from weather radar to estimate wet deposition from Chernobyl over England and Wales, and compare statistical results using these techniques for a large number of hypothetical release situations with more conventional approaches using limited data. More detailed storm modelling work is described to show how tainstorms can act as concentration mechanisms, and how variable the efficiency of removal may be for different situations.

22181 (EUR—11408, pp 193-199) **Retention of /sup 134/Cs and /sup 137/Cs by roof tiles.** Nicholson, K.W. (UKAEA Harwell Lab. Environmental and Medical Science Div.). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

Clay and concrete roof tiles have been collected from three buildings in southern England and analyzed for /sup 134/Cs and /sup 137/Cs surface activity. Collection took place a little over a year after the passage of a plume from the Chernobyl reactor accident and the execution of a similar study, in which the dry deposition velocity of particulate Cs was determined. Most tiles were taken from locations adjacent to those removed in the previous study and the weathering of Cs has been evaluated. The /sup 134/Cs on all of the tiles and the /sup 137/Cs on the concrete tiles could be ascribed to Chernobyl, however, substantial amounts of /sup 137/Cs on the clay tiles would be due to weapons fall-out also. The results indicate a limited amount of weathering for each Cs isotope, for the concrete tiles, with about 60-80% of the deposited material still remaining after a year. Retention by the clay tiles appeared to be even greater than for concrete but there was a wide variability in levels. Overall, for /sup 134/Cs, decay was found to be comparable to weathering for reducing activity on roofs, but the longer half-life of /sup 137/Cs means that weathering was correspondingly more important for this isotope. The low rate of weathering indicates that significant amounts of dry deposited material could remain on a roof for a number of years after a deposition episode.

22182 (EUR—11408, pp 208-221) **Deposition of beryllium-7 marked particles on surfaces in unfurnished and furnished rooms.** Roed, J.; Cannell, R.J. (Riso National Lab., Roskilde (DK); Imperial Coll. of Science and Technology, London (UK). Environmental Safety Group). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

Beryllium-7 created by cosmic radiation has been used as a tracer for investigating the deposition of small particles on surfaces in a furnished and an unfurnished room of a single-family dwelling at Riso (Denmark). The deposition onto internal surfaces in the entire house has also been studied. From these measurements the reduction in the inhalation dose caused by staying indoors during the passage of a cloud of particulate contamination over the area was calculated as a function of the air-exchange rate in the room or in the house. By comparing this study with others, it can be con-

cluded that internal deposition, rather than the filtering effect, is the dominant mechanism in reducing the inhalation dose. This work was supported by the EEC Radiation Protection Programme under contract No. B16-107-DK and by NKA, the Nordic Liaison Committee for Atomic Energy.

22183 (EUR—11408, pp 236-256) **Dynamic model of food chain transfers subsequent to radioactive fallout.** Maubert, H.; Roussel, S. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (FR). Inst. de Protection et de Surete Nucleaire). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

Within the MARIA program framework, the modelisation of the radioactivity transfer through the food chain after an accident was developed on a theoretical basis. The Tchernobyl event allowed to test this model on real scale. In this paper, using the results of field measurements, the modelisation of the deposits consequences is proposed, showing the relative importance of the main radionuclides found combined with the main items of the alimentary ration of human beings. In addition there will be an attempt to compute what the consequences would have been if the same accident had occurred in autumn, six months later.

22184 (EUR—11408, pp 257-268) **Accidental releases of radionuclides in waterways.** Smitz, J.S.; Everbecq, E. (Liege Univ. (BE)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

Radionuclides released in waterways are not simply transported by the water. Other complex phenomena occur: adsorption/desorption to sediments, sedimentation and accumulation on river's bed, interaction with interstitial water, and eventually resuspension in the water column. These processes present various time and length scales. The paper describes the major processes which govern the dynamic contamination of waterways in case of an accidental release, and presents a model which formulates the conservation of water, of sediments, and of radionuclides. This study is necessary to assess the dynamic transfer of radionuclides through aquatic ecosystems to man.

22185 (EUR—11408, pp 271-277) **New estimates of risk surfaces for somatic late effects of low doses of ionizing radiation.** Henrichs, K.; Paretzke, H.G.; Chmelevsky, D.; Gerken, M. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Muenchen, Neuherberg (DE)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

As already reported in previous presentations, in the Federal Republic of Germany several research facilities are presently involved in a reassessment of reactor accident consequences (reactor safety study Phase B). Among the data sets needed for this project, the Gesellschaft fuer Strahlen- und Umweltforschung (GSF) contributes risk estimates for late somatic effects (cancer, leukemia) of ionizing radiation. These risks have to be quantified for the general public depending on dose, age at exposure and on time after exposure (risk surfaces). The purpose of this paper is the presentation of the models and data used for these estimates, of the resulting calculated risks, of the open questions and of future improvements.

22186 (EUR—11408, pp 278-288) **Method for calculating time dependent individual and collective cancer risks in the accident consequence assessment code UFOMOD.** Steinhauer, C.; Matzerath, C.; Ehrhardt, J. (Kernforschungszentrum Karlsruhe G.m.b.H. (DE). Inst. fuer Neutronenphysik und Reaktortechnik). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

After an accidental release of radionuclides, a large fraction of the population may be exposed to protracted external and internal irradiation. To estimate the number of fatal stochastic somatic health effects as a function of time, in UFOMOD the concept of activity - risk coefficients has been introduced. These are pathway dependent coefficients normalized to initial unit activity concentrations in air or on ground, and quantify the risk as a function of time of an individual which is representative for the general population. Mathematically, the activity-risk coefficients are expressed by manifold integrals over age and life expectancy distributions of the population, the age and time dependence of the intake of activity for internal exposure pathways, the age and time dependence of the dose accumulation for all exposure pathways, and of the individual risk. The coefficients are precalculated, reducing the assessment of cancer fatalities in the ACA code to simple multiplications of the coefficients with the initial activity concentrations and with the numbers of individuals affected.

22187 (EUR—11408, pp 289-298) **Radiation exposure near Chernobyl based on analysis of conifer injury using thematic mapper satellite images.** Goldman, M.; Ustin, S.L.; Warman, E.A.; Sadowski, F.G. (California Univ., Davis (US). Lab. for Energy-Related Health Research; Stone and Webster Engineering Corporation, Boston, MA (US); EROS Data Center, Sioux Falls, SD (US)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

Radiation-induced damage in conifers adjacent to the damaged Chernobyl nuclear power plant has been evaluated using LANDSAT Thematic Mapper (TM) satellite images. Eight images acquired between 22 April 1986 and 15 May 1987 were used to assess the extent and magnitude of radiation effects on pine trees within 10 km of the reactor site. The timing and spatial extent of vegetation damaged was used to estimate the radiation doses in the near field around the Chernobyl nuclear power station and to indirectly derive the dose rates as a function of time during and after the accident. A normalized vegetation index was developed from the TM band data to visually demonstrate the damage and mortality to nearby conifer stands. The patterns of spectral change indicative of vegetation stress are consistent with changes expected for radiation injury and mortality. The extent and timing of these effects permitted the development of an integrated dose estimate, which was combined with the information regarding the characteristics of radionuclide mix, to provide an estimate of maximum dose rates during the early period of the accident. The derived peak dose rates during the 10-day release in the accident are high and are estimated at about 0.5 to 1 rad per hour. These are not considered life-threatening and would therefore require prompt but not immediate evacuation; that is, no off-site fatalities would be likely under such conditions. The methodology employed to combine remote-sensing analyses and the estimates of source term release with the known radiation effects on conifers represent a unique integration of these scientific and technical tools. The results of the study show that remote-sensing techniques can be used to develop a quantitative methodology for dosimetric applications and for future monitoring activities related to reactor safety.

22188 (EUR—11408, pp 301-311) **Applications of the new program system UFOMOD in the field of emergency response planning.** Burkart, K.; Ehrhardt, J.; Hasemann, I. (Kernforschungszentrum Karlsruhe G.m.b.H. (DE). Inst. fuer Neutronenphysik und Reaktortechnik). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

In addition to the main purpose of assessing the consequences of nuclear accidents, the new program system UFOMOD is designed to be a very flexible tool for investigation of alternatives

in emergency response planning and emergency management, and for studies of the differences in collective exposure due to different response of parts of the population (disregard or misinterpretation of alarms, spontaneous evacuation etc.). After a brief summary of the main features of the countermeasures submodel, scope, flexibility and variety of results are demonstrated by means of calculations with both an early short and a slightly delayed longer lasting release. Risks and benefits of 3 types of evacuation, i.e. prophylactic, during release and after passage of the plume, are discussed by comparing CCFDs of early fatalities. The number of injuries and fatalities as well as areas and numbers of persons affected by countermeasures may depend considerably on the intervention levels applied. Correlations between these quantities obtained within a parameter study are presented.

22189 (EUR—11408, pp 312-322) **Parameterization of the driving time in the evacuation or fast relocation model of an accident consequence code.** Pfeffer, W.; Hofer, E.; Nowak, E.; Schnadt, H. (Gesellschaft fuer Reaktorsicherheit, m.b.H. (GRS), Koeln (DE); Gesellschaft fuer Reaktorsicherheit, m.b.H. (GRS), Garching (DE); Technischer Ueberwabungs-Verein Rheinland e.V., Koeln (DE). Inst. fuer Unfallforschung und Ergonomie). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

The model of protective measures in the accident consequence code system UFOMOD of the German Risk Study, Phase B, requires the driving times of the population to be evacuated for the evaluation of the dose received during the evacuation. The parameter values are derived from evacuation simulations carried out with the code EVAS for 36 sectors from various sites. The simulations indicated that the driving time strongly depends on the population density, whereas other influences are less important. It was decided to use different driving times in the consequence code for each of four population density classes as well as for each of three or four fractions of the population in a sector. The variability between sectors of a class was estimated from the 36 sectors, in order to derive subjective probability distributions that are to model the uncertainty in the parameter value to be used for any of the fractions in a particular sector for which an EVAS simulation has not yet been performed. To this end also the impact of the uncertainties in the parameters and modelling assumptions of EVAS on the simulated times was quantified using expert judgement. The distributions permit the derivation of a set of driving times to be used as so-called "best estimate" or reference values in the accident consequence code. Additionally they are directly applicable in an uncertainty and sensitivity analysis.

22190 (EUR—11408, pp 323-332) **Effectiveness of various decontamination techniques for reducing external radiation doses to people living in an urban environment.** Brown, J.; Crick, M.J.; Hill, M.D. (National Radiological Protection Board, Chilton (UK)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

The NRPB has recently developed a dynamic model, EXPURT (EXPosure from Urban Radionuclide Transfer), that reflects the transfer processes that take place in the urban environment. Parameter values for the model have been derived from experiments performed in recent years in the United Kingdom and in Denmark. The model incorporates shielding properties of different types of buildings, and population habits to evaluate individual and population doses as a function of time after deposit. The original model has been extended to enable it to represent several techniques for decontaminating the various surfaces in the urban environment. These include hosing of impermeable surfaces, such as walls, roofs and paved areas, the removal or ploughing of soil/grass, and the replacement of building surfaces with new uncontaminated materials. The model has been used to examine the effectiveness of these various decontamination measures at reducing the external radiation doses to people living in urban areas. The importance of the time at which decontamination is performed is also discussed in this paper.

22191 (EUR—11408, pp 333-344) **Model for the calculation of the off-site economic consequences of nuclear reactor accidents.** Gallego, E.; Alonso, A. (Universidad Politecnica de Madrid (SP). Escuela Tecnica Superior de Ingenieros Industriales). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

The off-site economic cost of nuclear reactor accidents will depend on the countermeasures adopted to reduce its radiological impact. The assessment of the direct costs of emergency countermeasures (evacuation, early relocation and food disposal) as well as those of long-term protective actions (food disposal, decontamination or interdiction) is the objective of a model under development, with the sponsorship of the CEC Radiation Protection Programme, called MECA (Model for assessing the Economic Consequences of Accidents). The meteorological and socio-economical peculiarities of each site studied will be taken into account, by means of a flexible meteorological sampling scheme, which considers the geographical distribution of population and economic centers, and a data-base, compatible with the existing European grid, that contains the population distribution and the economic characteristics of the environs of the site to be studied with more detail near the reactor. The paper summarizes the particular models which will be included in MECA and shows the importance of site-specific adaptable modelling for economic risk evaluation.

22192 (EUR—11408, pp 345-356) **Progress in the preparation of demographic and land use data bases.** Garnier, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection Sanitaire). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

The object of the study is to gather and harmonize general data which are necessary to evaluate the radiological consequences of normal or accidental releases from nuclear industry for the E.C. population. In the first six months of 1987, two important series of data have been made available on magnetic support: French Land Use and U.K. agricultural productions. The two ones are dispatched in the 100 km2 meshes of the European grid. They are described and discussed in two internal reports of the Association EUROTAM/CEA. Some examples of U.K. agricultural productions will be shown during the workshop (as French land use data were at the last workshop). Other work has been made to present in the coarse grid (10 000 km2 elements) new member states population, as well as land use and agricultural data on the whole CEE (these ones using mainly an homogeneous set of regional statistics from Eurostat). Examples could be shown. Further improvements should consider additional or more detailed informations for some countries or regions. Detailed definitions and informations on the grid have been made available to some participants, and a notice is being prepared to enable larger cooperation.

22193 (EUR—11408, pp 359-368) **Uncertainty analysis of the atmospheric dispersion module of MARC.** Jones, J.A.; Hill, M.D. (National Radiological Protection Board, Chilton (UK)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

This paper describes an analysis of the uncertainty in the overall predictions of the MARC code stemming from uncertainties in the atmospheric dispersion module. Two analyses have already been carried out. These considered the uncertainty in the atmospheric dispersion module in predicting concentration and deposition at specific points and the uncertainty in the results of the food chain module. This analysis extends the earlier study of the dispersion module to the uncertainty on the predicted health effects, the

numbers of people evacuated and amounts of agricultural produce banned. The ranges of the consequences due to uncertainty in the dispersion parameters are described, and the parameters whose uncertainty makes major contributions to the overall uncertainty are considered. The ranges of the expectation value and the 90th-percentile for most of the endpoints considered are less than a factor of 8, with the range at the 90th-percentile usually being greater than that at the mean. The uncertainty on the amount of food banned, stemming from uncertainty in the atmospheric dispersion module, is comparable to that found in the earlier analysis of the food-chain module alone.

22194 (EUR—11408, pp 369-380) **UFOMOD - uncertainty and sensitivity analyses.** Fischer, F. (Kernforschungszentrum Karlsruhe G.m.b.H. (DE). Inst. fuer Neutronenphysik und Reaktortechnik). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

Uncertainty and sensitivity analysis techniques are used to quantify the impact of uncertain parameters in the atmospheric dispersion submodel on the predictions of the accident consequence code UFOMOD. Uncertainty bands show how much variability exists, sensitivity measures determine what causes the variability in consequences (concentrations, doses, health effects). The general procedure is indicated and some examples are given.

22195 (EUR—11408, pp 381-391) **Consideration of uncertainties in CCDF risk curves in safety oriented decision making processes.** Stern, E.; Tadmor, J. (Israel Atomic Energy Commission, Tel Aviv; Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

In recent years, some of the results of Probabilistic Risk Assessment (i.e. the magnitudes of the various adverse health effects and other effects of potential accidents in nuclear power plants) have usually been presented in Complementary Cumulative Distribution Function curves, widely known as CCDF risk curves. CCDF curves are characteristic of probabilistic accident analyses and consequence calculations, although, in many cases, the codes producing the CCDF curves consist of a mixture of both probabilistic and deterministic calculations. One of the main difficulties in the process of PRA is the problem of uncertainties associated with the risk assessments. The uncertainties, as expressed in CCDF risk curves can be classified into two main categories: (a) uncertainties expressed by the CCDF risk curve itself due to its probabilistic nature and - (b) the uncertainty band of CCDF risk curves. The band consists of a "family of CCDF curves" which represents the risks (e.g. early/late fatalities) evaluated at various levels of confidence for a specific Plant-Site Combination (PSC) i.e. a certain nuclear power plant located at a certain site. The reasons why a family of curves rather than a single curve represents the risk of a certain PSC have been discussed. Generally, the uncertainty band of CCDF curves is limited by the 95% ("conservative") and the 5% curves. In most cases the 50% (median, "best estimate") curve is also shown because scientists tend to believe that it represents the "realistic" (or real) risk of the plant.

22196 (EUR—11408, pp 395-404) **Accident consequence assessment and siting criteria development.** Kollas, J.G. (National Research Centre for the Physical Sciences Democritos, Athens (GR)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

The methodology developed is based on assessing the average over a large spectrum of meteorological conditions whole body collective dose resulting from a severe reference accident. The assessment of this dose is performed by code CRAC.GAEC, the Greek A.E.C. version of code CRAC2. The collective dose, which is chosen as a measure of the social radiation risk, is compared to the dose corresponding to a level of social risk encountered historically in energy production as a whole. The outcome of the comparison can be the determination of one or more sectors of acceptable sites for a set of specific conditions considered, such as the reactor characteristics. The present approach was aimed to deal with the problems stemming from the demographic idiomorphy of Greece, where one third of the country's population is concentrated in Athens, with the rest of the country exhibiting small population densities. One of the applications of the methodology developed concerned the identification of acceptable sites near Athens. For these sites the risk from the reference severe accident of a standard reactor to the over three millions inhabitants of Athens is less tan the risk corresponding to the same population that is due to energy production.

22197 (EUR—11408, pp 405-411) **Methods for using the results of probabilistic accident consequence assessments in decisions on the siting, design and operation of nuclear installations.** Hill, M.D. (National Radiological Protection Board, Chilton (UK)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

Over the past few years a great deal of effort has been devoted to the development of improved computer codes for carrying out probabilistic assessments of the consequences of potential accidents at nuclear installations. Much less effort has been spent on working out how to use the results of these assessments to provide a practical input to major decisions in siting, design and operation. This paper attempts to redress the balance. It begins with a description of the application of cost benefit analysis as an aid to decisions and identifies the limitations of this approach. It then goes on to outline an alternative approach based on multi-attribute utility theory. The advantages of this technique are its flexibility, in terms of the number of factors which can be included in the analysis, and its transparency, in the sense that the details of how a decision is arrived at can be more easily explained. Nevertheless, use of a multi-attribute utility approach does entail difficulties in assigning weights to be attributed to each of the factors included in an analysis. These difficulties are discussed in the paper and it is concluded that they should not be an obstacle to pursuing the approach.

22198 (EUR—11408, pp 412-423) **Probabilistic assessment, for Italian sites, of the consequences of severe accidents and of the actions taken for protection of the population.** Iachetta, R.; Sassani, F.; Serra, S. (ENEL, Rome (IT)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

The study performed by ENEL with the CRAC 2 code aimed at obtaining, with a probabilistic treatment of the meteorological data, a detailed evaluation of the effects of the actions taken for protection of the population during a severe accident at two reference sites. The source term taken into consideration during the severe accident refers to two different situations: the first situation represents the worst possible scenario with a large dry containment, the second situation represents an envelope source term that is in line with the present European trends. Of the CRAC 2 code the stratified sampling option was used, with the meteorologic matrix of all the one-year data relating to the two reference sites. The paper also examines the probability distribution that better approximates the individual dose (whole body and thyroid) and the related cumulative probabilistic distribution function. A parametric analysis takes into account the fact that the source term has negligible associated energy and release height, whereas the release duration may vary. With regard to the emergency reference value given for the equivalent whole body dose, a discussion is presented on the implications of comparing with said values the equivalent whole body dose or the effective dose computed in case of a severe accident. A sensitivity analysis was performed of the benefits afforded by evacuation at different speeds, sheltering in the different exposure paths,

and iodine prophylaxis started at different times during the accident. The results of the analyses give useful indications for preparation of the emergency plans, and confirm that in the short time the combination of sheltering and iodine prophylaxis, adequately balanced with a graded evacuation of the population from the areas close to the plant, gives the best protection of the population in the case of severe accidents.

22199 (EUR—11408, pp 39-49) **Outline of CONDOR - a new UK probabilistic accident consequence analysis code.** Cooper, P.J.; Brearley, I.R.; Boardman, J.; Nixon, W.; Egan, M.J.; Nair, S.; Ponting, A.C.; Hill, M.D.; Haywood, S.M.; Jones, J.A. (UKAEA Safety and Reliability Directorate, Clucheth; Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

A new probabilistic consequence analysis code, called CONDOR, is being developed within a collaborative project involving the Safety and Reliability Directorate of the UK Atomic Energy Authority, Berkeley Nuclear Laboratories of the Central Electricity Generating Board and the UK National Radiological Protection Board. A high-level modular structure has been devised for the code along with detailed specifications for the interfaces between the various modules. The resulting code architecture represents a flexible computationally efficient system, which allows for a wide variety of modelling features. This will ensure that the system is readily able to handle the results of current and future research, without changes to the architecture, and is capable of performing wide ranging uncertainty/sensitivity analysis. Throughout the project a rigorous Quality Assurance (QA) procedure is being followed, involving a large number of reviews and tests covering, inter alia, models to be included in the code, code design (including system flexibility from, for example, the point of view of including, at some future date, new models and data) and computer coding practices. Additionally, the results of all reviews and tests are being carefully documented so that compliance with QA requirements can be demonstrated.

22200 (EUR—11408, pp 424-438) **Consequence assessment for design basis accidents of nuclear power plants: results of a comparison exercise performed by the Commission of the European Communities.** Lange, F. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (DE)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

The Task Force on Safety Objectives (T.F.S.O.) of the CEC has initiated a benchmark exercise with the purpose to review the methods and data used in dose assessment being adopted in various countries to estimate doses from design basis accidents of nuclear power plants within a regulatory framework. This benchmark exercise forms one of the initiatives of the T.F.S.O. to enable a comprehensive intercomparison of the degree of coherence between the dose-frequency targets used in different Members States for application to design basis accidents. The structure, contents and results of the benchmark exercise in which eight countries/institutions participated are described. Some of the more important findings and conclusions and the relation to a parallel benchmark exercise on source terms for design basis accidents are discussed.

22201 (EUR—11408, pp 439-450) **Radiation dose estimate for accident postulated at some potential location of the nuclear power plant in Yugoslavia.** Tomas, P.; Limic, N.; Rendic, D.; Novosel, N.; Tudoric-Ghemo, J. (Institut Rudjer Boskovic, Zagreb (YU)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

The postulated accident consequence assessment is basic criteria for the nuclear energy programme and selection of the reactor technology as well as for comparative analysis of site characteristics for nuclear power plant. Radiation dose estimate is important for the emergency response in the case of radioactive release. Statistical approach for evaluation of monitoring data have been developed by using the linear least square estimation. Further work is planned on this topic, in particular on the determination of the basic statistics. One attempt to compare RBMK - Chernobyl and PWR nuclear power plant Krsko have been made from nuclear safety points of view. Dose estimate have been also made for release from normal operation and postulate accident scenario. In the case of atmospheric dispersion smaller dose estimate have been obtained for the nuclear power plant on the Adriatic coast.

22202 **(GRS-F—169) Reports on research programs in the field of reactor safety sponsored by the Federal Ministry for Research and Technology. Reported period: January 1 - June 30, 1988.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Oct 1988. 399p. (In German). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88757358/JAW.

Each progress report represents a compilation of individual reports about objectives, the work performed, the results, the next steps of the work etc. The individual reports are prepared in a standard form by the contractors themselves as a documentation of their progress in work and published by the FB Forschungsbetreuung (research coordination department) at the GRS, within the framework of general information of progress in reactor safety research. The individual reports are classified according to the research program on the safety of LWR 1977-1980 of the BMFT. Another table of contents uses the same classification system as applied in the nuclear safety index of the CEC (Commission of the European Communities) and the OECD (Organization for Economic Cooperation and Development). The reports are arranged in the sequence of their project numbers.

22203 **(GRS-F—170) List of reports in the field of reactor safety research of BMFT, CEA, EPRI, JSTA and USNRC. Reported period: 1 July - 30 September 1988.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Nov 1988. 46p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757359/JAW.

This list reviews reports from the Federal Republic of Germany, from France, from Japan and from the United States of America concerning single problems in the field of reactor safety research. According to the cooperation, these reports are available in the Gesellschaft fuer Reaktorsicherheit (GRS). The list pursues the following order: Country of origin, problem area concerned, according to the Reactor Safety Research Program of the BMFT, reporting organization. The list of reports appears quarterly.

22204 **(INIS-mf—11918) Review on special occurrences in nuclear power plants in the Federal Republic of Germany in 1987.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). [1988]. 43p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757367/JAW.

In 1987, 303 special occurrences were recorded. 93% of the special occurrences were in the lowest reporting category, N. The other occurrences were in categories E (medium category) and V (pre-commissioning phase). No special occurrences were recoded in the highest reporting category, S, in 1987. There were no release or discharges of radioactive substances of more than the licensed levels. In no case was there any danger to persons or to the environment. The special occurrences were analyzed in the light of various aspects. The analyses revealed no systematic weak spots.

22205 **(INIS-XN—162) Act of 9 June 1988 (1988:875) to amend the Nuclear Liability Act (1968:45).** (International Atomic Energy Agency, Vienna (Austria)). Jul 1988. 1p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706189/JAW.

This Act raises the nuclear operator's liability for a nuclear incident from 500 million to 800 million Swedish Kronor. The amendment enters into force on 1 January 1989.

22206 **(INIS-XN—170) S.I. 1987 No.688, The Nuclear Installations (Isle of Man) (Variation) Order 1987.** (International Atomic Energy Agency, Vienna (Austria)). 7 May 1987. 3p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706197/JAW.

This Order, which amends the Nuclear Installations (Isle of Man) Order 1977, came into force on 7 May 1987. The Nuclear Installations (Isle of Man) Order 1977 extends certain provisions of the Nuclear Installations Act 1965 as appropriate, to the Isle of Man. This Order extends amendments made to that Act by the Energy Act 1983 and the Congenital Disabilities (Civil Liability) Act 1976, as appropriate, to the Isle of Man. (NEA).

22207 **(IVEM—14-B) Dutch debate on reactor safety. The intermediate situation in 1986.** Aldenkamp, F.; Biesiot, W.; Geerts, H.M.; Nienhuys, K.; Soppe, W. (Vereniging van Wetenscappelijke Werkers, Utrecht (Netherlands). Ad-hoc werkgroep kernenergie). (Rijksuniversiteit Groningen (Netherlands). Interfacultaire Vakgroep Energie en Milieukunde). Jun 1986. 193p. (In Dutch, English). NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE88706211/JAW.

A survey is presented of the discussion on location sites for nuclear power plants in the Netherlands and the USA. It consists of two parts (A and B). This part (B) goes farther into the American reports already introduced briefly in part A. They are the reports of the IDCOR (nuclear power industry), ANS (American Nuclear Society), APS (American Physical Society), NRC (Nuclear Regulatory Commission) and UCS (Union of Concerned Scientists). Of each report a summary in English and an extended summary in Dutch is presented. Parts of the text of chapter 3 of the report 'Reactor accidents: the source term discussion' of the Technical University Twente (BC8501, 1985) are presented. 65 refs.; 15 figs.; 32 tabs.

22208 **(JAERI—1313) Research on one-dimensional two-phase flow. Theory on hydrodynamic balance in two-fluid model and its application.** Adachi, Hiromichi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Oct 1988. 162p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88757242/JAW.

In Part I the fundamental form of the hydrodynamic basic equations for a one-dimensional two-phase flow (two-fluid model) is described. Discussions are concentrated on the treatment of phase change inertial force terms in the equations of motion and the author's equations of motion which have a remarkable uniqueness on the following three points. (1) To express force balance of unit mass two-phase fluid instead of that of unit volume two-phase fluid. (2) To pick up the unit existing mass and the unit flowing mass as the unit mass of two-phase fluid. (3) To apply the kinetic energy principle instead of the momentum low in the evaluation of steady inertial force term. In these three, the item (1) is for excluding a part of momentum change or kinetic energy change due to mass change of the examined part of fluid, which is independent of force. The item (2) is not to introduce a phenomenological physical model into the evaluation of phase change inertial force term. And the item (3) is for correctly applying the momentum law taking into account the difference of representative velocities between the main flow fluid (vapor phase or liquid phase) and the phase change part of fluid. In Part II, characteristics of various kinds of high speed two-phase flow are clarified theoretically by the basic equations derived. It is demonstrated that the steam-water two-phase critical flow with violent flashing and the airwater two-phase critical flow without phase change can be described with fundamentally the same basic equations. Furthermore, by comparing the experimental data from the two-phase critical discharge test and the theoretical prediction, the two-phase discharge coefficient, C/sub D/, for large sharp-edged orifice is determined as the value which is not affected by the experimental facility characteristics, etc.

22209 **(JAERI-M—88-202) Power ramp experiment of fuel rods in JMTR boiling capsules.** Uchida, Masaaki; Nakamura, Jinichi; Ichikawa, Michio; Kashima, Yoichi; Sezaki, Katsuji; Ishii, Tadahiko; Iwai, Takashi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Oct 1988. 56p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88757247/JAW.

Test fuel rods of Japanese origin were power ramp tested in the Power Ramping Facility (BOCA/OSF-1) in the JMTR. Test fuel rods simulating the BWR 8 x 8 type and PWR 17 x 17 type were base-irradiated in the OWL-2 loop to burnups of 5 - 8 MWd/kg-U, and seven rods (five type-B and two type-P) were then transferred to the BOCA and power ramped from the initial power level of 30 kW/m to peak power levels of 48 - 56 kW/m. Three rods out of them were given maximum 300 power cycling after reaching the peak power. The remaining two rods were held at the peak power for more than 50 hours. None of the rods failed, nor defected. In pararell with the above tests, ramp testing of fresh fuel rods was made. Five fuel rods were prepared with small gap size and iodine addition aiming at an in-pile stress corrosion experiment of the cladding tubes. Failure occurred in only one rod which had extremely thinned cladding.

22210 **(KAERI/RR—528/86) Development of compact nuclear simulator.** Ham, Chang Shik; Kwon, Kee Choon; Lyu, Sung Pil; Kim, Jung Taek; Kim, Young Gill; Hwang, In Ku. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Dec 1986. 101p. (In Korean). NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88705844/JAW.

Every one knows that the TMI accident resulted from the defeat of the man-machine interfacing of main control room design and of the quality of the operators. So it is necessary to develop CNS which is very efficient to train operators, operation and maintenance supervisors, maintenance personnel and inspectors of regulation committee to uderstand the dynamic transient phenomena. The following are major parts of this projects: 1. Data collection and review. 2. Make into a contract for CNS with STUDSVIK. 3. Selection of malfunction. 4. Design of console panel and modification. 5. List up measuring instruments. We design and make CNS with STUDSVIK in Sweden, and install a simulator in Nuclear Training Center of KAERI not only for fundamental training of nuclear power plant, but also safety analysis by transient analysis and NSSS design.

22211 **(KFK—4485) Chemical interactions of reactor core materials up to very high temperatures.** Hofmann, P.; Hagen, S.; Schanz, G.; Skokan, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung 1 - Teilinstitut Kernbrennstoffe; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Ingenieurtechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projektgruppe LWR-Sicherheit). Jan 1989. 75p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88757376/JAW.

The paper describes which chemical interactions may occur in a LWR fuel rod bundle containing (Ag, In, Cd) absorber rods or (Al/sub 2/O/sub 3//B/sub 4/C) burnable poison rods with increasing temperature up to the complete melting of the components and the formed reaction products. The kinetics of the most important chemical interactions has been investigated and the results are described. In most cases the reaction products have lower melting points or ranges than the original components. This results in a relocation of liquefied components often far below their melting points. There exist three distinct temperature regimes in which liquid phases can form in the core in differently large quantities. These temperature regimes are described in detail. The phase relations in the important ternary (U, Zr, O) system have been extensively studied. The effect of steel constituents on the phase relations is given in addition. All the considerations are focused on PWR conditions only.

22212 **(LA—11440-PR) Space nuclear safety program: Progress report, July--September 1987.** George, T.G. (comp.). (Los Alamos National Lab., NM (USA)). Feb 1989. Contract W-7405-ENG-36. 20p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008308/JAW.

This quarterly report describes studies related to the use of $^{238}PuO_2$ in radioisotope power systems, carried out for the Office of Special Nuclear Projects of the US Department of Energy by Los Alamos National Laboratory. The studies discussed are ongoing; the results and conclusions described may change as the work progresses. 20 figs., 4 tabs.

22213 **(NRPB-R—224) NRPB methodology for assessing the radiological consequences of accidental releases of radionuclides to atmosphere - MARC-1.** Hill, M.D.; Simmonds, J.R.; Jones, J.A. (National Radiological Protection Board, Chilton (UK)). Oct 1988. 50p. H.M. Stationery Office, London, price Pound 5.00.

The NRPB has developed a methodology for the assessment of public health related consequences of accidental releases of radionuclides from nuclear facilities. The methodology is implemented through a suite of computer programs predicting the transfer of activity from point of release to the atmosphere, to the population. The methodology and programs are entitled MARC - Methodology for Assessing Radiological Consequences. The original versions of the programs contained a number of assumptions primarily appropriate for analyses of potential light water reactor accidents. These sections have been modified to make them more flexible and more generally applicable. The opportunity has also been taken to improve some of the models incorporated in the code and to update some of the databases used. A version of MARC, designated MARC-1, is available for general use outside NRPB. This report describes the state of the MARC-1 suite of programs and associated databases. The report also indicates some applications for which MARC has been used since the original version.

22214 **(NUREG—0090-Vol.11-No.3) Report to Congress on abnormal occurrences, July--September 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Jan 1989. 36p. NTIS, PC A03/MF A01 - GPO - OSTI. Order Number TI89007968/JAW.

Section 208 of the Energy Reorganization Act of 1974 identifies an abnormal occurrence as an unscheduled incident or event which the Nuclear Regulatory Commission determines to be significant from the standpoint of public health or safety and requires a quarterly report of such events to be made to Congress. This report covers the period from July 1 to September 30, 1988. For this reporting period, there were no abnormal occurrences at nuclear power plants licensed to operate. There were two abnormal occurrences under other NRC-issued licenses: multiple medical therapy misadministrations at a single hospital and a medical diagnostic misadministration. There was one abnormal occurrence reported by an Agreement State (Texas) involving a medical diagnostic misadministration. The report also contains information updating some previously reported abnormal occurrences.

22215 **(NUREG—1355) The status of recommendations of the President's Commission on the accident at Three Mile Island: A ten-year review.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of the Executive Director for Operations). Mar 1989. 96p. NTIS, PC A05/MF A01 - GPO - OSTI. Order Number TI89008576/JAW.

This report summarizes the status of actions taken by the US Nuclear Regulatory Commission (NRC) in response to recommendations made by the Presidential Commission on the Accident at Three Mile Island in the 10 years since the accident occurred in March 1979. It also updates NRC's initial response to the Presidential Commission's recommendations contained in "NRC Views and Analysis of the Recommendations of the President's Commission of the Accident at Three Mile Island" (NUREG-0632), issued in November 1979. The status of ongoing initiatives for actions not yet complete is also reported for reference purposes. On the basis of its analysis of NRC and the industry, the Presidential Commission found many then-current practices inadequate and in need of improvement. As a result of its recommendations and of guidance from other studies, substantial changes have been made in the 10 years since the accident. This report reflects how, based on Presidential Commission recommendations and continued work, revised practices and standards are now being implemented by NRC and throughout the industry.

22216 **(NUREG/CR—4496-Vol.2) A system for generating long streamflow records for study of floods of long return period: Phase 2.** Franz, D.D.; Kraeger, B.A.; Linsley, R.K. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Linsley, Kraeger Associates Ltd., Los Gatos, CA (USA)). Feb 1989. 218p. NTIS, PC A10/MF A01 - GPO - OSTI. Order Number TI89008575/JAW.

Knowledge of the return periods of large floods is required to make risk analyses for nuclear power plants subject to flooding from rivers. The system reported here combined the stochastic simulation of hourly rainfall data and daily pan evaporation data with the deterministic simulation of streamflow by using the synthetic rainfall and evaporation data as input to a calibrated rainfall runoff model. The sequence of annual maximum flood peaks from a synthetic record of 10,000 years or more was then analyzed to obtain estimates of flood frequency. The reasonableness of the flood frequency results must be evaluated on the degree of mimicry of the key characteristics of the observed rainfall data and the ability of the rainfall-runoff model to mimic the observed flood frequency during the calibration period. On this basis, the flood frequency results appeared to be a reasonable extrapolation of the data used in defining the model parameters. There is a need to develop regional parameters for the stochastic models and to conduct research on the relationship between the stochastic structure of rainfall and stochastic structure of flood frequency. The methodology is applicable, assuming a highly skilled analyst, to watersheds similar to those already tested.

22217 **(NUREG/CR—5311) An assessment of RELAP5/MOD2 applicability to loss-of-feedwater transient analysis in a Babcock and Wilcox reactor plant.** Dimenna, R.A.; Hall, D.G.; Kullberg, C.M.; Larson, T.K.; Larson, J.R.; Watkins, J.C. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1989. Contract AC07-76ID01570. 112p. (EGG—2560). NTIS, PC A06/MF A01 - GPO - OSTI. Order Number TI89008299/JAW.

The applicability and scaling capability of RELAP5/MOD2 when applied to a Babcock and Wilcox (B and W) loss-of-feedwater transient is assessed using a code applicability methodology. A loss-of-feedwater test with a feed-and-bleed recovery was selected from the once-through integral system (OTIS) test data as a reference transient. Nondimensional comparisons are made between code assessment calculations and code applications calculations using computer code models scaled according to scaling criteria derived from the work of Ishii and others. The results indicate that RELAP5/MOD2 can scale the phenomena observed in the experiment and that the code is applicable for transients for which phenomena are within this envelope. The results also demonstrate the usefulness of the code applicability methodology for interpreting and verifying code calculations. 21 refs., 59 figs., 12 tabs.

22218 **(OEFZS—4477) Fission product behaviour - international programs and Austrian contributions.** Sdouz, G. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Institut fuer Energie- und Anlagentechnik, Seibersdorf (Austria)). (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Nov 1988. 51p. (In German). (EA—325/88). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88706121/JAW.

An overview of the most important programs on source term investigations is given. Projects performed in the Federal Republic of Germany and in the USA are described in detail. One of these projects - the OECD-LOFT-Test LP-FP-1 was the basis of Austrian contributions. The results of the Austrian work are summarized. At last the structure and several models of the Source Term Code Package are presented. 26 refs., 23 figs.

22219 **(SAND—87-2675C) An overview of in-vessel release and chemical modeling in severe accident analysis codes.** Grimley, A.J. III; Wheatley, C.J.; Clough, P.N. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 22p. (CONF-880604—16). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007427/JAW.

From Joint meeting of the 195th national meeting of the American Chemical Society and the 3rd Chemical Congress of North America; Toronto, Canada (5 Jun 1988).

This paper reviews the chemistry and other pertinent modeling, transport, release and aerosol physics in several of the more commonly distributed codes and code suites. The ordering will be by physical region (i.e., fuel, coolant flow, and structures) rather than by code (or code suite) since the modeling requirements differ greatly from region to region. The primary goal of the review is to discuss how chemistry affects the modeling of fission product release and transport (and hence has an overall effect on the source term) and to what extent the effects of chemistry are treated in existing codes. The data requirements of the models and the computational, difficulties of treating many of the processes realistically, are also discussed.

22220 **(SAND—88-1436C) Generic and plant specific applicability of recent NRC-sponsored level 1 PRAs.** Cramond, W.R. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-890405—14). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005205/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

Four Level I probabilistic risk assessments (PRAs) have been completed by Sandia National Laboratories and its contractors in support of the NUREG-1150 program. The applicability of the methodology used and the results from these four analyses are discussed in this paper. The methods used are clearly applicable and reasonably efficient for any light water reactor (LWR) PRA. some of the results have generic applicability, but many are either plant specific or relate only to similar plants or plants with the same system configuration on a particular issue. In this paper, important aspects of systems that affect dominant accident sequences, such as station blackout, and that could be important at other plants are discussed. 12 refs., 2 tabs.

22221 **(SAND—88-1455C) An evaluation of internal event level 1 PRA methods used in NUREG-1150.** Camp, A.L.; Cramond, W.R. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 6p. (CONF-890405—12). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005232/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

As part of the effort to support NUREG-1150, Sandia National Laboratories and its subcontractors have developed innovative techniques for efficiently performing internal event Level I probabilistic risk assessments. This methodology is one of the alternatives for industry to use in performing individual plant evaluations in the future. While this new methodology was very successful, there are some areas where improvements can be made. This paper evaluates the strengths and weaknesses of the methodology and makes some important recommendations for modifications in order to provide insights to future users. 10 refs.

22222 **(SAND—88-1463C) Techniques for applying sets code procedures to large fault trees in PRA [Probabilistic Risk Assessment] analysis.** Daniel, S.L.; Payne, A.C. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 6p. (CONF-890405—10). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004823/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

In this paper, we describe some of the new techniques developed in the Risk Methods Integration and Evaluation Program (RMIEP) for solving large fault trees and for performing external event analysis to the same level of detail as the internal event analysis by manipulating the original internal event fault trees to include component location information. Approximations or simplifications of these techniques were used in the NUREG-1150 analyses for both internal and external events. 5 refs.

22223 **(SAND—88-1468C) The effect of increasing level of modeling detail in probabilistic risk assessments.** Whitehead, D.W.; Payne, A.C. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 12p. (CONF-890405—7). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004581/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

This paper examines the effect of increasing the level of modeling detail in five probabilistic risk assessments. Relationships between the level of detail and the kinds of system interactions that may or may not be identified are discussed. Finally, the expandability to higher levels of details and the objectives that can be achieved for different levels of detail are discussed. 6 refs., 4 tabs.

22224 **(SAND—88-1470C) The use of expert opinion and thermal-hydraulic analysis to resolve PRA [Probabilistic Risk Assessment] issues.** Payne, A.C. Jr.; Dingman, S.E. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-890405—13). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005213/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

In this paper, we discuss the integration of expert judgement and thermal-hydraulic analyses in a Probabilistic Risk Assessment (PRA) in order to realistically resolve modeling and quantification issues. To illustrate this process, we have chosen to use the analysis of equipment survivability in severe environments for long term containment heat removal failure (TW) sequences performed as part of the LaSalle Unit II Level III PRA. The same method was also used in the NUREG-1150 analysis of the Peach Bottom Plant to resolve this issue. In PRA, not only is a best estimates of the risk desired but also a measure of the uncertainty in the result is needed to help make an accurate assessment of the implications of the PRA. Therefore, uncertainty must be addressed. In this example, we discuss how the uncertainties resulting from thermal-hydraulic analysis and expert judgement were incorporated into the final analysis, how they were propagated through to estimates of risk, and the implications for future improvements in PRA. 18 refs., 2 figs., 2 tabs.

22225 **(SAND—88-1688C) An uncertainty/sensitivity analysis of MACCS code.** Helton, J.C.; Johnson, J.D.; Rollstin, J.A.; Chanin, D.I.; Jow, H.N.; Sprung, J.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 12p. (CONF-890405—11). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005237/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

An uncertainty/sensitivity analysis performed with the MACCS computer code for the early health effects associated with a severe nuclear reactor accident is described. Results obtained in this study indicate that (1) the impact of consequence modeling uncertainty in an integrated risk assessment may be significant; (2) dominant variables involving early health effects include scaling for horizontal dispersion, population relocation time, dry deposition velocity, and groundshine shielding; (3) the models in MACCS related to early health effects are implemented correctly; and (4) model resolution may be improved by finer radial gridding. 32 refs., 5 tabs.

22226 **(SAND—88-1755C) Incorporation of Melcor source term predictions into probabilistic risk assessments.** Summers, R.M.; Helton, J.C.; Leigh, C.D. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 9p. (CONF-890405—16). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005335/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

The MELCOR code has been developed as an advanced computational tool for performing primary source term analyses that will incorporate current phenomenological understanding into probabilistic risk assessments (PRAs). Although MELCOR is reasonably fast running, it is not feasible to perform a MELCOR calculation for each of the thousands of sets of conditions requiring a source term estimate in an integrated PRA. Therefore, the RELTRAC code is being developed to generate secondary source term estimates for use directly in a PRA for the LaSalle nuclear power plant by appropriately manipulating results from calculations by a primary source term code such as MELCOR. This paper describes the MELCOR and RELTRAC models and the manner in which MELCOR calculations are used to provide input to the RELTRAC model. 26 refs., 2 figs., 1 tab.

22227 **(SAND—88-2100C) Overview of methodology used for NUREG-1150 risk analyses.** Bergeron, E.D.; Breeding, R.J.; Helton, J.C. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-890405—19). NTIS, PC A02 - OSTI. Order Number DE89007421/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

Five probabilistic risk assessment (PRAs) form the basis for the conclusions in the recent Nuclear Regulatory Commission's report "Severe Accident Risks: An Assessment for Five US Nuclear Power Plants" (NUREG-1150). Four of the five PRAs were conducted at Sandia National Laboratories (SNL); the fifth was conducted at Idaho National Engineering Laboratory and Brookhaven National Laboratory. The analysis methods used for the risk analyses were developed at SNL. This paper describes those methods and how they differ from methods used in other PRAs. 16 refs., 2 figs., 1 tab.

22228 **(SAND—88-2160C) Observations concerning the COMPBRN III fire growth code.** Nicolette, V.F.; Nowlen, S.P.; Lambright, J.A. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 9p. (CONF-890405—17). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005334/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

Nuclear power plant fire probabilistic risk assessments (PRAs) usually involve application of a fire growth model to calculate fire growth and the time required to damage critical safety equipment. Attempts to use the fire growth model COMPBRN III resulted in the observation of problems and nonphysical behavior in the code. In this paper the causes of these problems and nonphysical behavior are identified and possible modifications suggested. Incorporation of these modifications into COMPBRN III results in some significant differences in the calculated fire damage times, as well as making the code more physically realistic. 12 refs., 6 figs.

22229 **(SAND—88-3353C) An overview of the fire risk scoping study objectives, approach, findings and follow-on efforts.** Nowlen, S.P.; Lambright, J.A.; Nicolette, V.F.; Bohn, M.P. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 13p. (CONF-890405—18). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005212/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

The Fire Risk Scoping Study was sponsored by the US Nuclear Regulatory Commission and performed at Sandia National Laboratories. The study was initiated as a result of previous USNRC-sponsored fire research efforts that had identified certain fire risk issues which had not been addressed in previously completed commercial nuclear power plant fire risk analyses. The specific objectives of this study were (1) to review and requantify fire risk scenarios from four fire probabilistic risk assessments (PRAs) in light of updated data bases made available as a result of USNRC sponsored Fire Protection Research Program and updated computer fire modeling capabilities, (2) to identify potentially significant fire risk issues that have not been previously addressed in a fire risk context and to quantify the potential impact of those identified fire risk issues where possible, and (3) to review current fire regulations and plant implementation practices for relevance to the identified unaddressed fire risk issues. 8 refs., 2 tabs.

22230 **(SAND—88-3355C) The impact of updated information and modeling techniques on four previously completed commercial nuclear power plant fire probabilistic risk assessments.** Lambright, J.A.; Nowlen, S.P.; Nicolette, V.F.; Bohn, M.P. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 11p. (CONF-890405—8). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004580/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

This paper presents the results of a review and updates of specific scenarios from four previous fire risk assessments. These four probabilistic risk assessments are those performed for Limerick, Indian Point Unit 2, Oconee, and Seabrook. The requantification work included the use of updated data bases and fire modeling techniques. Changes made to Indian Point Unit 2, Limerick, and Seabrook subsequent to the original risk assessment in response to implementation of 10CFR50 Appendix R have also been included in the requantification. For Oconee no Appendix R changes made subsequent to the performance of the original risk assessment were identified. Also presented is a discussion of the primary contributors to uncertainty in the analyses. 12 refs., 2 tabs.

22231 **(SAND—88-3361C) A cause-coupling-defense approach to common cause failures.** Parry, G.W.; Paula, H.M.; Mitchell, D.B.; Rasmuson, D.M. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 11p. (CONF-890405—9). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004579/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

The status and recent history of common cause failures (CCF) research are briefly reviewed. Current US Nuclear Regulatory Commission research in the area of CCFs is described with emphasis on the remaining problem areas. These include deficiencies in data and the need to more completely understand the characteristics of CCFs. The concepts and relationships of root cause, coupling, and defensive mechanisms are discussed. Key definitions and some in-depth analysis of these concepts are included. An overview of the recent research to be published is presented. This research includes (1) the cause-defense methodology for analyzing CCFs, (2) guidelines for identifying potential CCFs as part of a nuclear power plant walkdown and procedures review, and (3) requirements for an industry-wide data base, including documentation of failure events and additional component failure and failure mode data requirements to support future PRAs. 5 refs.

22232 **(SPH—02-03) Project for review of nuclear energy in the Netherlands. Chernobyl, reactions and developments.** Jong, J.J. de (ed.); Ministerie Economische Zaken, Den Haag (NL). Directoraat Generaal Energie, dir. Elektriciteit en Kernenergie. (Stuurgroep Project Herbezinning, The Hague (Netherlands)). Mar 1988. 32p. (In Dutch). Library, KNAW; Postbus 41950, 1096 DD Amsterdam, Netherlands.

In consequence of the accident, national as well as international activities have been undertaken, in particular in the areas of reactor safety and environmental impacts. The international activities were concentrated at IAEA in Vienna, NEA in Paris and the EG. Nationally regarded, the accident has induced the project Review and the working plan for rounding-off Chernobylsk. In general it could be noted that one has learned lessons from the accident in the areas of reactor safety and environmental impacts. 22 refs.

22233 **(SPH—03-04) OSART-mission-report and post-OSART-workplan nuclear power plant Borssele.** IAEA, Vienna (AT); N.V. PZEM, Middelburg (NL); Ministerie van Sociale Zaken en Werkgelegenheid, Den Haag (NL). Directoraat-Generaal van de Arbeid, Kernfysische Dienst. (Stuurgroep Project Herbezinning, The Hague (Netherlands)). 1988. 56p. (In Dutch). Library, KNAW; Postbus 41950, 1096 DD Amsterdam, Netherlands.

In the period October 6th-24th 1986 an OSART team of the IAEA has visited the nuclear power plant Borssele in order to examine the conduction of operation of the power plant. The findings of the team are embodied in the OSART report and in addition recommendations have been made in order to come to an improved safe conduction of operation. The team found that the power plant was well maintained and operated by an experienced staff, but that the operation safety could be improved, in particular the surveillance and controls. On the basis of the OSART report a post-OSART working plan has been drawn up. This working plan encloses all measures and activities which are/have been performed on the basis of the recommendations of the OSART report. From April 6th to 10th 1987 a follow-up OSAR team has come in order to verify if the measures taken were adequate and have embodied their findings in a sequel OSART report. Herein it has been laid down by the team that the measures were sufficient. One has recommended however to put priorities and to introduce long term projects gradually into the organization.

22234 **(SPH—03-05) OSART-mission-report and post-OSART-workplan nuclear power plant Dodewaard.** IAEA, Vienna (AT); N.V. GKN, Dodewaard (NL); Ministerie van Sociale Zaken en Werkgelegenheid, Den Haag (NL). Directoraat-Generaal van de Arbeid, Kernfysische Dienst. (Stuurgroep Project Herbezinning, The Hague (Netherlands)). Mar 1988. 48p. (In Dutch). Library, KNAW; Postbus 41950, 1096 DD Amsterdam, Netherlands.

In the period April 27th-May 15th 1987 an OSAR team of the IAEA has visited the nuclear power plant Dodewaard in order to examine the conduction of operation of the power plant. The findings of the team are embodied in the OSART report and in addition recommendations have been made in order to come to an improved safe conduction of operation. The team found that the power plant was well maintained and operated by a conscientious and dedicated staff. The general impression was that the actual personnel equipment and apparatus insures a sufficiently safe conduct of operation. The post-OSART working plan has been drawn up by the N.V. GKN, according to the OSART-report. The working plan encloses all measures and activities which are/have been performed on the basis of the recommendations of the OSART report.

22235 **(SPH—03-06) Fire safety study of Dodewaard and Borssele nuclear power plants.** Ministerie van Sociale Zaken en Werkgelegenheid, Den Haag (NL). Directoraat-Generaal van de Arbeid, Kernfysische Dienst; Ministerie Binnenlandse Zaken, Den Haag (NL). Directoraat-Generaal voor Openbare Orde en Veiligheid, Inspectie voor het Brandweerwezen. (Stuurgroep Project Herbezinning, The Hague (Netherlands)). Mar 1988. 32p. (In Dutch). Library, KNAW; Postbus 41950, 1096 DD Amsterdam, Netherlands.

From the nuclear and conventional fire safety audits of both Dutch nuclear power plants performed under supervision of the Nuclear Safety Inspectorate and the Inspectorate for the Fire Services it turns out that the fire safety is sufficient however amenable for improvement. Besides a detailed description of the method of examination, the study 'Fire Safety' contains the results of the audit and 14 respectively 15 recommendations for improvement of the fire safety in Dodewaard and Borssele. The suggested recommendations which are applicable to both power plants are the following: fire fighting training for operators and guards, a complete emergency ventilation system of the control room, increase in the number of detectors and alarms, an increase in the quantity of water available for high-pressure fire fighting, improvement of fire barriers between several redundancies of nuclear safety systems, an investigation and possible improvement of the heat and radiation protection offered by presently used fire fighting suits. For Dodewaard a closed emergency staircase in the reactor building (secondary containment) is deemed necessary for personnel emergency escape routes and continued fire fighting if required.

22236 **(SPH—03-08) Project 'Safety of nuclear power plants', safety analyses Borssele and Dodewaard. Susceptibility for reactivity accidents.** Munk, P. de (ed.); Ministerie van Sociale Zaken en Werkgelegenheid, Den Haag (NL). Directoraat-Generaal van de Arbeid, Kernfysische Dienst; Energie Onderzoek Centrum Nederland, Petten (NL). (Stuurgroep Project Herbezinning, The Hague (Netherlands)). Mar 1988. 24p. (In Dutch). Library, KNAW; Postbus 41950, 1096 DD Amsterdam, Netherlands.

Although from a reactor physics point of view the RBMK-reactor differs remarkably from the nuclear power plant in Borssele and Dodewaard, the safety with regard to reactivity transients was investigated for these plants. The study contributes to the overall project 'Future Nuclear Power' that was initiated by the government of the Netherlands after the accident in Chernobyl. The report states that due to the inherent physical characteristics severe reactivity transients as a consequence of operational occurrences can practically be excluded. The consequences of design basis accidents characterized by rapid withdrawal from the reactor core of a control rod, are limited because the reactor coolant system boundary will remain intact. 6 refs.

22237 **(SPH—03-09) Consultative study on accident management measures for the nuclear power plants of Borssele and Dodewaard.** Kersting, E. (and others) (eds.); Ministerie van Sociale Zaken en Werkgelegenheid, Den Haag (NL). Directoraat-Generaal van de Arbeid, Kernfysische Dienst; Gesellschaft fuer Reaktorsicherheit mbH (GRS), Koeln (DE). (Stuurgroep Project Herbezinning, The Hague (Netherlands)). Mar 1988. 108p. (In German). Library, KNAW; Postbus 41950, 1096 DD Amsterdam, Netherlands.

The report presents a number of recommendations for the existing nuclear power plants at Borssele and Dodewaard to reduce the core melt frequency and to mitigate the consequences, should a core melt accident occur. GRS states that this is possible through a more extensive use of existing safety function capabilites as well as through measures that enhance the containment function. It is stated that such measures are worthwhile to be considered if a further reduction of an already small risk can be obtained at the cost of a reasonable effort. 36 refs.; 24 figs.; 4 tabs.

22238 **(SPH—04-11) Survey of intervention working values.** Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, Den Haag (NL). Directie Stralenbescherming. (Stuurgroep Project Herbezinning, The Hague (Netherlands)). Spr 1988. 56p. (In Dutch). Library, KNAW; Postbus 41950, 1096 DD Amsterdam, Netherlands.

As part of the Nuclear Energy Review, a number of studies have been carried out on such matters as the economic consequences, the environmental impact and the feasibility of evacuation in the event of a nuclear accident. In these studies it was important to have values on the basis of which it is possible to assume for the calculations whether and at what time a measure to protect the population is carried out. The countermeasures considered are shielding, iodine prophylaxis, evacuation, return to abandoned areas and food and drinking water restrictions. These values are called working intervention values or working values for short. The report provides a summary of the working values used in the review studies. In general, intervention values or intervention levels are values which indicate when it is appropriate for a government to take action. 28 refs.; 11 figs.; 14 tabs.

22239 **(SPH—05-12) Feasibility of evacuation.** Ministerie van Binnenlandse Zaken, Den Haag (NL). Interdepartementale werkgroep 'evacuatie'. (Stuurgroep Project Herbezinning, The Hague (Netherlands)). Spr 1988. 48p. (In Dutch). Library, KNAW; Postbus 41950, 1096 DD Amsterdam, Netherlands.

The main question is whether evacuation of people is feasible in case of accidents with a nuclear power plant. The limiting conditions of this question are extracted from other studies. This study is therefore focused on a postulated accident in a newly built nuclear power plant with an electric capacity of 1000 Megawatt and a source term of one percent. In this particular case an evacuation should take place within the period between the accident and

the emission of nuclear materials. Initial focus is on the administrative-organizational aspects of evacuation. Then bottlenecks in the technical implementation of evacuation are determined. An analysis is made for each potential Dutch location (Borssele, Eemshaven, Maasvlakte, Moerdijk and Westelijke Noordoostpolderdijk) of a nuclear power plant. By means of a model the following question is examined: can the population leave the danger area or be evacuated on time, under certain circumstances. It is concluded that preventive evacuation of the population from the planned locations is feasible, but at Moerdijk complications may occur because of the presence of some homes for the elderly and a nursing home. 18 refs.; 7 figs.; 2 tabs.

22240 **(SPH—06-13) Economic damage caused by a nuclear reactor accident. Main report.** Goemans, T.; Schwarz, J.J. (and others) (eds.); Stichting Samenwerkende Instellingen t.b.v. Beleidsanalyse Studies (SIBAS), Delft (NL). (Stuurgroep Project Herbezinning, The Hague (Netherlands)). Spr 1988. 116p. (In Dutch). Library, KNAW; Postbus 41950, 1096 DD Amsterdam, Netherlands.

This study is directed towards the estimation of the economic damage which arises from a severe possible accident with a newly built 1000 MWE nuclear power plant in the Netherlands. A number of cases have been considered which are specified by the weather conditions during and the severity of the accident and the location of the nuclear power plant. For each accident case the economic damage has been estimated for the following impact categories: loss of the power plant, public health, evacuation and relocation of population, export of agricultural products, working and living in contaminated regions, decontamination, costs of transportation and incoming foreign tourism. The consequences for drinking water could not be quantified adequately. The total economic damage could reach 30 billion guilders. Besides the power plant itself, loss of export and decreasing incoming foreign tourism determine an important part of the total damage. 12 figs.; 52 tabs.

22241 **(SPH—06-14) Economic damage caused by a nuclear reactor accident. Mobility of radionuclides in the soil.** Sman, H.T.; Weststrate, F.A.; Loxham, M. (eds.); Grondmechanica Delft (NL). Afd. Chemie en Milieugeotechniek; Stichting (SIBAS), Delft (NL). (Stuurgroep Project Herbezinning, The Hague (Netherlands)). Spr 1988. 84p. (In Dutch). Library, KNAW; Postbus 41950, 1096 DD Amsterdam, Netherlands.

A technical study in the framework of an investigation into the economical damage of an accident with a nuclear power plant is reported. The study addresses the consequences for the soil, the production of vegetables, meat and water (for consumption) of the assumed accident with the hypothetical new nuclear power plant in the Netherlands. The accident itself is described on the basis of two source terms following which the amount and mutual ratio of the radioactive materials efflued from the reactor confinement can be estimated. With these source terms 1% and 0.1% respectively of the volatile radioactive materials of the reactor content will be found outside the affected power plant. From the large number of radionuclides which efflues in such an accident iodine, strontium and cesium are selected, which are considered to cause the larger part of the economic damage. Starting from the source term one has computed for certain weather circumstances for the Moerdijk location and the western part of the North-East Polder, where and at which amounts the nuclides considered will be deposited upon the earth surface. The nuclides precipitated upon the earth surface may cause loss of function of the bottom. The concentration development of the nuclides considered in the bottom has been calculated and, using transfer factors between bottom and products, the concentration of the nuclides in the products was determined. On the basis of the standards determined it has been assessed which products are not consumable for a certain period. Distinction has been made in loss of function for agricultural land, pasture and the drinking water supply. 32 refs.; 17 figs.; 31 tabs.

22242 **(SPH—06-15) Economic damage caused by a nuclear reactor accident. Impacts of radioactive contamination of surface waters.** Baan, P.J.A. (ed.); Waterloopkundig Laboratorium/WL (NL). (Stuurgroep Project Herbezinning, The Hague (Netherlands)). Spr 1988. 80p. (In Dutch). Library, KNAW; Postbus 41950, 1096 DD Amsterdam, Netherlands.

The impacts of a nuclear reactor accident have been estimated for: the public water supply; the use of surface water for sprinkling in agriculture, for industry water supply, recreation, etc.; and fisheries. Contamination of water sources may affect the public water supply severely. In such a situation demand of water cannot always be met. Agriculture faces production losses, if demand for uncontaminated surface water cannot be met. The impacts on recreation can also be significant. The losses to other water users are less substantial. Fisheries may lose (export) markets, as people become reluctant to buy fish and fish products. 33 refs.; 3 figs.; 35 tabs.

22243 **(SPH—06-16) Economic damage caused by a nuclear reactor accident. Agricultural-economic impacts.** Giessen, L.B. van der (ed.); Landbouw-economisch Instituut (NL). (Stuurgroep Project Herbezinning, The Hague (Netherlands)). Spr 1988. 72p. (In Dutch). Library, KNAW; Postbus 41950, 1096 DD Amsterdam, Netherlands.

The agricultural economic consequences of a nuclear reactor accident consist of production losses and export losses. Production losses are mainly suffered during the first months in case of an accident in May, because of the loss of grass in the affected area during six weeks and the loss of horticultural products under glass during three months as a consequence of the lack of uncontaminated water. The export losses are mainly caused by the loss of a part of the regular export markets by psychological factors. It can be concluded that export losses so predominate in total losses that the investigated accident scenario does not seem to be very important. Good information to consumers at home and abroad will be necessary to reduce export losses as much as possible. 3 figs.; 45 tabs.

22244 **(SPH—06-20) Economic damage caused by a nuclear reactor accident. Description economic analysis.** Vlist, J.A. van der; Vlies, J. van der; Beumer, L.; Nederlands Economisch Instituut, Rotterdam (NL). (Stuurgroep Project Herbezinning, The Hague (Netherlands)). Spr 1988. 124p. (In Dutch). Library, KNAW; Postbus 41950, 1096 DD Amsterdam, Netherlands.

The economic damage caused by an eventual accident in a nuclear power plant consists of the loss of the power plant itself and of the damage caused by radioactive contamination of the environment. In this study twelve accidents have been studied. For eleven of these cases the total economic damage for the Netherlands was estimated to amount to 14-17 thousand million guilders. Only in one case the economic damage could reach 30 thousand million guilders. In this case a strongly urbanized area would be struck by a severe accident and a stringent policy with respect to contamination would be pursued. 6 figs.; 51 tabs.

22245 **(SPH—08-18) Severe reactor accidents reviewed. Environmental impacts.** Hienen, J.F.A. van; Roelofsen, P.M.; Poley, A.D. (eds.); Energieonderzoek Centrum Nederland (ECN), Petten (NL). (Stuurgroep Project Herbezinning, The Hague (Netherlands)). Spr 1988. 92p. (In Dutch). Library, KNAW; Postbus 41950, 1096 DD Amsterdam, Netherlands.

Consequences to the environment of airborne releases of radioactive materials after a severe accident at a nuclear power plant are reported. In addition to the radioactive contamination of the environment, health effects due to the exposure to ionizing radiation from the dispersed radioactive materials are considered. Detrimental health effects have been studied at two sites: Moerdijk and a fictitious reference site. No acute fatalities are expected. Less than 100 cases of acute non-fatal illnesses are expected when countermeasures are taken into consideration, and averaging over all possible weather conditions. For specific weather conditions (appearing 5% of the time) 0 to 1000 cases are expected, whereas for the remaining other weather conditions no cases of illness due to radiation are ex-

pected. When no countermeasures are taken, the average number of acute non-fatal illnesses is 2000. For late lethal effects (tumours) the individual risk is calculated as maximal 0.15% for those living within 15 km of the damaged nuclear power plant, and maximal 0.05% for those living in the contaminated area beyond this region. For comparison: the general risk of death by cancer is more than 30% at present in the Netherlands. 47 refs.; 24 figs.; 21 tabs.

22246 **(SPH—08-19) Severe reactor accidents reviewed. Environmental impacts: appendices.** Hienen, J.F.A. van; Roelofsen, P.M.; Poley, A.D.; Energieonderzoek Centrum Nederland (ECN), Petten (NL). (Stuurgroep Project Herbezinning, The Hague (Netherlands)). Spr 1988. 84p. (In Dutch). Library, KNAW; Postbus 41950, 1096 DD Amsterdam, Netherlands.

Consequences to the environment of airborne releases of radioactive materials after a severe accident at a nuclear power plant are reported. In addition to the radioactive contamination of the environment, health effects due to the exposure to ionizing radiation from the dispersed radioactive materials are considered. Detrimental health effects have been studied at two sites: Moerdijk and a fictitious reference site. No acute fatalities are expected. Less than 100 cases of acute non-fatal illnesses are expected when countermeasures are taken into consideration, and averaging over all possible weather conditions. For specific weather conditions (appearing 5% of the time) 0 to 1000 cases are expected, whereas for the remaining other weather conditions no cases of illness due to radiation are expected. When no countermeasures are taken, the average number of acute non-fatal illnesses is 2000. For late lethal effects (tumours) the individual risk is calculated as maximal 0.15% for those living within 15 km of the damaged nuclear power plant, and maximal 0.05% for those living in the contaminated area beyond this region. For comparison: the general risk of death by cancer is more than 30% at present in the Netherlands. 50 refs.; 17 figs.; 19 tabs.

22247 **(VROM—71015-1-88) Measurements of radioactive and xenobiotic substances in the biological environment in the Netherlands 1986. Annual report of the Coordinating committee for the monitoring of radioactive and xenobiotic substances.** (Coordinatie-Commissie voor de Metingen van Radioactiviteit en Xenobiotische Stoffen (CCRX), Rijswijk (Netherlands)). Jan 1988. 70p. (In Dutch). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88706135/JAW.

Includes English summary.

A brief survey of the results of detailed radioactivity measurements performed in the Netherlands during the period immediately after the Chernobylsk accident, and the risk analyses made on the basis of these results, are presented. The increase of the airborne radioactivity and the activity concentrations in surface water during the first week of May 1986 is demonstrated graphically. The radiation dose in 1986 due to artificial radioactivity has been calculated to be about 60 μSv for adults, 70 μSv for ten-year-old children and 110 μSv for one-year-old children. 54 figs.; 32 tabs.

22248 **(WHC-SA—0357) Using fault trees to aid in developing an initiating event list for probabilistic risk assessments.** Coles, G.A. (Westinghouse Hanford Co., Richland, WA (USA)). Dec 1988. Contract AC06-87RL10930. 6p. (CONF-890405—22). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008792/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

This paper describes how using the built-in intelligence of linked fault trees to help identify initiating events can be an important part of a Probabilistic Risk Assessment analysis. It describes how this identification was done on a microcomputer-based application for a reactor Probabilistic Risk Assessment. It discusses results of this application and describes how this technique helped in discovering initiating events that may have been otherwise overlooked. 2 refs.

22249 **(WHC-SA—0361) Breaking the logic loop to complete the Probabilistic Risk Assessment.** Coles, G.A.; Powers, T.B. (Westinghouse Hanford Co., Richland, WA (USA)). Dec 1988. Contract AC06-87RL10930. 8p. (CONF-890405—24). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008794/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

A Level 1 Probabilistic Risk Assessment was performed for the N Reactor at the Hanford Site near Richland, Washington. This work was performed by the operating contractor for the US Department of Energy. As part of this analysis, fault trees were constructed for the various front-line and support systems necessary to respond to transient conditions. At the N Reactor, the normal operating system is also the initial accident mitigating system. Alternating current (ac) power is required for many components that must function to control and mitigate transient conditions. The reactor has two independent and redundant sources of ac power. The first source is the offsite ac power grid. The second source is produced onsite by a dedicated turbine generator, powered by reactor or oil-fired boiler steam. Some components that require steam-generated ac power play a role in generation of reactor or boiler steam. Thus, feedback mechanisms that create logic loops exist for various components and their power source. A large number of logic loops were broken so that the fault trees could be quantified. The advantage of the N Reactor Probabilistic Risk Assessment method for breaking these logic loops is that is provides a systematic and documentable approach that has not been described in Probabilistic Risk Assessment literature to date. 3 refs., 4 figs.

22250 **(WHC-SA—0481) The use of Probabilistic Risk Assessment in the safety assessment of Hanford nuclear facilities.** Armstrong, G.R. (Westinghouse Hanford Co., Richland, WA (USA)). Dec 1988. Contract AC06-87RL10930. 9p. (CONF-890405—23). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008793/JAW.

From International topical meeting on probability, reliability and safety assessment; Pittsburgh, PA, USA (2 Apr 1989).

The Probabilistic Risk Assessment of the Hanford Site started about 3 years ago. The first facility studied was the N Reactor. A limited-scope Probabilistic Risk Assessment was completed in 1987 that showed the N Reactor met US Nuclear Regulatory Commission Probabilistic Risk Assessment goals and its risk to the public was comparable to the commercial industry. An N Reactor Level 3 Probabilistic Risk Assessment is under way and is scheduled for completion September 1989. The Level 1 phase is complete and results indicate a core damage frequency of 6.4 E-05/yr. A Fast Flux Test Facility Probabilistic Risk Assessment was started January 1989 and is due to be completed January 1992. Other major Probabilistic Risk Assessment activities are anticipated for the nonreactor facilities presently operating and planned at the Hanford Site. 5 refs., 4 figs.

22251 **(ORNL/tr—89/12) Compressed air vacuum system for localization of accidents in nuclear reactors.** Sykora, D. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. Translation of German Democratic Republic Patent No. 160 446, 8 March 1983. 13p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008819/JAW.

The invention, entitled "Compressed Air Vacuum System for Localization of Accidents in Nuclear Reactors" concerns a limited but important area of nuclear energy that is currently being developed and implemented in the COMECON member states in the form of specific government programs. The invention solves the problem of increasing the operating safety of the strategic safety system in standardized nuclear power plants by means of two loops of Soviet design and by homogenization of a corresponding system of technical elements, as well as by the maximum possible improvement in the reparability of the most sensitive elements of the system. The nature of the invention lies in the fact that water seals are used instead of the large-sized double return valves and that the entire valve system of the Barbotage condenser, which requires frequent inspection and maintenance, is located in the second chamber, which has better access during normal operation. From the standpoint of the technological, hydraulic and thermal engineering

parameters of the system, the modification described is characterized only by positive effects. The invention is an asymmetrical, one-sided, i.e., reverse impermeable high-pressure water seal, which consists of a pipeline, the water seal, and a water seal tank. It is characterized by complete leaktightness and complete operating safety, through which is guaranteed the necessary hydraulic-thermal uniformity of operation of the multichannel, parallel-connected system mentioned above. 1 fig.

22252 **(ORNL/tr—89/8) Nuclear reactor of the hot water type.** Hannerz, K.; Rytterne, R.; Holm, T. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. Translation of European Patent 31,541 A2, December 16, 1980. 29p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number TI89008815/JAW.

A nuclear reactor of the BWR type is furnished with a control system for the control rods, which enables an automatic shutdown of the reactor in case of malfunction. The control system functions completely independent of energy supplied from outside the reactor. The control rods are arranged in channels so that they can move freely. These channels are connected at the bottom to a distribution chamber, which is filled with water, and at their upper end they are connected to the surrounding reactor space by means of openings. The reactor is furnished with a pump, which generates an excess pressure in the distribution chamber compared to the surrounding space. This excess pressure generates a hold force, which is able to hold the control rod in a position outside the reactor core. The control rod channels are connected to operating devices through control pipes. The operating devices generate an impulse, which cause a change in the position of the control rods. This document describes the design of the control system.

22253 **Nuclear plant aging research program.** Eissenberg, D.M. (Oak Ridge Nat. Lab., Oak Ridge, TN (US)). pp v of Use of new technology to improve mechanical readiness, reliability and maintainability. Shives, T.R. New York, NY; Cambridge University Press (1987). (CONF-8504306—).

From 40. National Bureau of Standards Mechanical Failures Prevention Group meeting; Gaithersburg, MD, USA (16 Apr 1985).

The U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, has established the Nuclear Plant Aging Research (NPAR) program in its Division of Engineering Technology. Principal contractors for this program include Oak Ridge National Laboratory, Brookhaven National Laboratory, Idaho National Engineering Laboratory, and Pacific Northwest Laboratory. The program goals are: to identify and characterize time-dependent degradation (aging) of nuclear plant safety-related electrical and mechanical components which could lead to loss of safety function; to identify and recommend methods for detecting and trending aging effects prior to loss of safety function so that timely maintenance can be implemented; and to recommend maintenance practices for mitigating the effects of aging. Research activities include prioritization of system and component aging in nuclear plants, characterization of aging degradation of specific components including identification of functional indicators useful for trending degradation, and testing of practical methods and devices for measuring the functional indicators. Aging assessments have been completed on electric motors, snubbers, motor-operated valves, and check valves. Testing of trending methods and devices for motor-operated valves and check valves is in progress.

25 ENERGY STORAGE

REFER ALSO TO CITATION(S) 21778

2501 Magnetic

22254 **High temperature superconducting magnetic energy storage for future NASA missions.** Faymon, K.A.; Rudnick, S.J. (National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH (US); Argonne National Lab., Argonne, IL (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889416.

Several NASA sponsored studies based on "conventional" liquid helium temperature level superconductivity technology have concluded that superconducting magnetic energy storage has considerable potential for space applications. The advent of high temperature superconductivity (HTSC) may provide additional benefits over conventional superconductivity technology, making magnetic energy storage even more attractive. The proposed NASA space station is a possible candidate for the application of HTSC energy storage. Alternative energy storage technologies for this and other low Earth orbit missions are compared.

22255 **U.S. program to develop superconducting magnetic energy storage.** Schoenung, S.M.; Hassenzahl, W.V.; Filios, P.G. (W.J. Schafer Associates, Inc., 6140 Stoneridge Mall Rd., Pleasanton, CA (US); Lawrence Berkeley Lab., Accelerator Research Div., Berkeley, CA (US); Defense Nuclear Agency, 6801 Telegraphy Rd., Alexandria, VA (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889504.

The United States Government, along with the Electric Power Research Institute (EPRI), has initiated a program to develop Superconducting Magnetic Energy Storage (SMES). This program is designed to answer questions of technical and economic viability by the mid-1990s, thereby paving the way to commercialization. EPRI has supported this technology since 1981 and is interested in its potential use in diurnal electric load-leveling. The U.S. Government has an additional interest in the potential of SMES to power ground-based lasers for Strategic Defense purposes. This paper presents a brief description of SMES technology, a review of the programmatic aspects of the ongoing program, including EPRI and DoD objectives, critical issues, and program milestones. The potential impact of high temperature superconductors on SMES is also discussed.

2502 Compressed Gas

REFER ALSO TO CITATION(S) 22851

22256 **(NEDOJ-P—8722) Feasibility study on compressed air energy storage power generating systems.** (Electric Power Development Co. Ltd., Tokyo (Japan)). May 1988. 131p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756486/JAW.

Feasibility study on compressed air energy storage power generating systems has been conducted from engineering aspects of available underground cavity construction technology and gas turbine technology to determine the availability in Japan. The study has been conducted along the following underlying themes: (1) use of existing technologies, (2) enhancement of overall system efficiency, (3) as a substitute for pumped storage generation. Five turbo-train application cases and two underground cavity application cases were selected. For each of these cases, geological conditions and estimated construction costs were studied. The capacity of turbo trains was set 300 MW class under the operating condition of 6 hours generation and 7 hours compressed air storage. On underground cavities, after conducting studies, it was found that the pressure compensation type is only slightly more efficient than the pressure noncompensation type. Meanwhile, it was found that the pressure noncompensation type is closer to commercial viability, and the construction costs of two types are nearly same level. Based on these rosults, the pressure noncompensation type appears to be more advantageous from the view point of available civil engineering technology with which to construct underground cavities. (44 figs, 22 tabs, 12 refs)

2506 Thermal

REFER ALSO TO CITATION(S) 21970, 22387

22257 (PNL-SA—16647) Thermal energy storage for power generation. Drost, M.K. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1989. Contract AC06-76RL01830. 12p. (CONF-890351—8). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009382/JAW.

From Thermal energy storage program review; New Orleans, LA, USA (15 Mar 1989).

There are increasingly strong indications that the United States will face wide-spread electrical power generation capacity constraints in the 1990s with most regions of the country experiencing capacity shortages by the year 2000. Using the National Electricity Reliability Council's base case predictions, the mid-Atlantic, Northeast, and Southeast regions of the country will experience generating capacity constraints by the year 2000. In many cases, the demand for increased power will occur during peak demand periods. If the country is to avoid further dependence on petroleum fuels, alternatives to oil- and gas-fired turbines and combined-cycle plants need to be developed. A number of demand-side and system-wide energy options exist but when new generation is unavoidable, the only non-petroleum option is a cycling coal-fired power plant. A preliminary evaluation of an alternative method of using coal to generate peak and intermediate load power was conducted by the Pacific Northwest Laboratory (PNL). The approach uses a continuously operating coal-fired salt heater to heat molten nitrate salt, which is then stored. During peak demand periods, the hot salt is used as a heat source for a conventional steam/Rankine power plant. This paper discusses this idea. 9 refs., 2 figs., 1 tab.

22258 (PNL-SA—16701) Overview of the seasonal thermal energy storage program. Kannberg, L.D. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1989. Contract AC06-76RL01830. 21p. (CONF-890351—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009161/JAW.

From Thermal energy storage program review; New Orleans, LA, USA (15 Mar 1989).

Seasonal thermal energy storage (STES) has the potential to provide storage for large-scale industrial and building heating and cooling at many sites in the United States. It is one of a number of technologies required to help meet national energy needs to reduce peak electrical demand, improve energy utilization efficiency, facilitate use of renewable and domestic energy sources, as well as reduce emissions causing global climate changes. The US Department of Energy (DOE) is conducting a research and development program to develop STES technologies. Development of aquifer thermal energy storage (ATES) is currently emphasized because of its wide applicability and relatively low cost. Current efforts are focused on developing the necessary knowledge base to design and operate ATES systems. This knowledge base includes geohydraulic, geochemical, and geomicrobiologic features affecting design, performance, and institutional acceptability of ATES systems. The scope of activities includes numerical model development and application, laboratory geochemical and microbiologic evaluation, and field performance testing and monitoring. Additional efforts are underway to identify the best ways to integrate ATES with end uses. Future plans follow three primary thrusts: (1) complete investigation of fundamental ATES phenomena and development of design aids (such as computer models), (2) begin assertive technology transfer and assist implementation by cost-shared feasibility studies and pilot-scale field tests/demonstrations, and (3) begin investigations of other promising STES technologies, such as ice storage, rock borehole, and earth STES. 3 refs., 3 figs., 1 tab.

22259 (PNL-SA—16703) Targets for early commercialization of aquifer thermal energy storage technology. Hattrup, M.P.; Meijo, R.O. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1989. Contract AC06-76RL01830. 17p. (CONF-890351—5). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009162/JAW.

From Thermal energy storage program review; New Orleans, LA, USA (15 Mar 1989).

This study generated and then screened a list of potential entry market applications for aquifer thermal energy storage (ATES). Several screening criteria were used to identify promising ATES applications. An in-depth analysis was conducted of the four most promising applications. The application that best met the criteria for early ATES commercialization is the cooling of large industrial structures that are currently not being air conditioned. Storage of certain types of fruits and vegetables also appears to be an attractive application for ATES. Shopping malls do not represent a good initial entry market application. Heating, ventilation, and air conditioning (HVAC) systems in shopping malls must be very reliable and extremely sensitive to small changes in temperature. 8 refs.

22260 (PNL-SA—16706) Geochemical research for high-temperature aquifer thermal energy storage. Jenne, E.A.; McKinley, J.P.; Smith, R.W. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1989. Contract AC06-76RL01830. 6p. (CONF-890351—3). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009154/JAW.

From Thermal energy storage program review; New Orleans, LA, USA (15 Mar 1989).

The goal of these investigations is to develop the capability to predict and thereby avoid the geochemical problems that have plagued most aquifer thermal energy storage (ATES) systems. The experimental work focuses on the DOE-funded Field Test Facility (FTF) at St. Paul, Minnesota. Samples from the storage aquifer (Galesville Sandstone) are being used in closed-system (hydrothermal) laboratory experiments at 60{degree}, 90{degree}, and 120{degree}C. These results are being used to improve the reliability of speciation and solubility calculations made with the MINTEQ geochemical model (GCM) in high-temperature ATES systems. A "reaction" model is being constructed of minerals important in regulating those dissolved constituents that form scale and cause clogging. A mixing model is being developed to permit calculation of the extent of mixing of the thermally treated water with native ground water to facilitate interpreting the composition of the withdrawn water. The GCM improvements, development of a generic mixing model, determination of a site-specific reaction model, and reconciliation of laboratory and St. Paul FTF data are designed to permit assessment of potential geochemical problems at future ATES sites as well as to reduce capital investment and the start-up and operating costs. 8 refs., 4 figs.

22261 (PNL-SA—16717) Status of numerical models for ATES [Aquifer Thermal Energy Storage]. Vail, L.W. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1989. Contract AC06-76RL01830. 7p. (CONF-890351—6). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009159/JAW.

From Thermal energy storage program review; New Orleans, LA, USA (15 Mar 1989).

Research is under way to develop a suite of codes suitable for simulation of geohydrothermal behavior and geochemical behavior of Aquifer Thermal Energy Storage (ATES) Systems. Once developed, these tools will be applied to assist research and will be modified, if necessary, for use by architect/engineer firms. Special attention is being given to geohydrothermal tools focused on assessing ATES feasibility and on preliminary design. In addition, an expert system is being developed to provide geotechnical ATES expertise to groups unfamiliar with the technology. 8 refs., 1 tab.

22262 (PNL-SA—16723) Microbiological features of aquifer thermal energy storage systems. Hicks, R.J.; Thompson, T.E.; Brett, C.E.; Allison, F.S.; Neville, J.A.; Shea, C.; Winters, A.L. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1989. Contract AC06-76RL01830. 18p. (CONF-890351—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009160/JAW.

From Thermal energy storage program review; New Orleans, LA, USA (15 Mar 1989).

A study was initiated to determine the environmental effects of aquifer thermal energy storage (ATES) technology pertaining to microbial communities indigenous to ATES and the propagation, movement, and release of pathogenic microorganisms within ATES systems. Six water samples from various locations within a chill

ATES system in Tuscaloosa, Alabama, were obtained to develop a microbial profile. In addition, two head wells were sampled using glass slides/solid support device (SSD) to assess the importance of adhering microbial populations. Bacteria were observed in all water samples collected Heterotrophic bacteria represented the largest group observed. In addition, coliforms and pseudomonad (bacteria that may be opportunistic human pathogens) were observed in many of the samples. However, no true human pathogens were observed in the water or solid support samples. Although preliminary, the data suggests that chill ATES does not increase the level of pathogenic microorganisms in aquifers. 14 refs., 1 fig., 5 tabs.

2508 Chemical

REFER ALSO TO CITATION(S) 22351

2509 Batteries

REFER ALSO TO CITATION(S) 22337, 22343, 22461, 22462, 22542, 22715

22263 **(EIR—637) Development of an Al/Cl fuel cell. Final report.** Haas, O.; Mayor, J.C. (Paul Scherrer Inst. (PSI), Wuerenlingen (Switzerland)). Dec 1987. 54p. (In German). Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland).

Experiments with LiCl-KCl melts and with aqueous, weakly acid NaCl solutions were carried out. The electrochemical properties of the aluminium in these electrolytes were investigated and the efficiency and performance constancy of electricity-generating Al/Cl/sub 2/ cells were tested. The studies on melts were restricted to small cells for research in the range of 1 Watt and on the investigation of the thermodynamic behaviour of the aluminium electrode in this melt. In aqueous solutions, the parasitic hydrogen formation could be largely suppressed by adding small quantities of Zn/sup 2/ +In/sup 3+/ or In/sup 3+/+Hg/sup 2+/ etc. and the electrochemical oxidation of the aluminium could be shifted to more negative potentials. Interestingly, almost the same results are obtained for Al 99.99 and Al 99.5 (quality of filler wire). Together with the addition of In/sup 3+/+Hg/sup 2+/ in aqueous solution, the Al/Cl/sub 2/ cells had a terminal voltage of up to 2.65 V. An energy output of 47% could be achieved for a current density of 50 mA/cm/sup 2/. The aqueous electrolytes made it also possible to construct more efficient cells. Three cylindrical cell modules with a power of 25 Watts and modules with plane-parallel electrode arrangement with a total power of 200 Watts were built. The modules showed a high performance constancy. Current and voltage are only reduced at a concentration of aluminium ions of over 1.5 M. The dissolved aluminium could be separated from the electrolyte by means of a cation exchanger.

22264 **(LBL—25507) Technology base research project for electrochemical energy storage: Annual report for 1987.** Kinoshita, Kim (ed.). (Lawrence Berkeley Lab., CA (USA)). Jul 1988. Contract AC03-76SF00098. 63p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008860/JAW.

This report summarizes the progress made by the Technology Base Research (TBR) Project for Electrochemical Energy Storage during calendar year 1987. The primary objective of the TBR Project, which is sponsored by the Department of Energy (DOE) and managed by Lawrence Berkeley Laboratory (LBL), is to identify electrochemical technologies that can satisfy stringent performance and economic requirements for electric vehicles and stationary energy storage applications. The ultimate goal is to transfer the most promising electrochemical technologies to the private sector or to another DOE project (e.g., Sandia National Laboratories' Exploratory Technology Development and Testing Project) for further development and scale-up. Besides LBL, which has overall responsibility for the TBR Project, Los Alamos National Laboratory (LANL), Brookhaven National Laboratory (BNL) and Argonne National Laboratory (ANL) participate in the TBR Project by providing key research support in several of the project elements. The TBR Project consists of three major project elements: exploratory research; applied science research and; air systems research. The objectives and the specific battery and electrochemical systems addressed by each project element are discussed in the following sections, which also include technical summaries that relate to the individual projects. Financial information that relates to the various projects and a description of the management activities for the TBR Project are described in the Executive Summary. 19 figs., 1 tab.

22265 **(LBL—25817) Technology base research on the slurry-zinc/air battery system: Final report.** Sierra Alcazar, H.B.; Nguyen, P.D.; Pinoli, A.A. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 41p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008638/JAW.

The slurry-Zn/air battery system has received renewed R & D interest because it does not have the shape-change problems of batteries with Zn-plate electrodes and can sustain higher current densities and specific peak power than other metal-air battery systems. Additional advantages of the slurry-Zn/air battery include safety, low environmental impact, potential low cost, and separation of energy density from power density functions for design purposes. In this work we present results obtained at the individual cell level as a basis to estimate the performance of a secondary slurry-Zn/air battery system. The expected specific energy of such systems has been increased as a result of the use of capacity-extension additives, which has been one of the major thrusts of this work. 8 refs., 20 figs., 5 tabs.

22266 **(NEDO-P—8721) Investigation on the feasibility of the secondary battery application to electric cars.** (New Energy and Industrial Technology Development Organization, Tokyo (Japan)). Mar 1988. 218p. (In Japanese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88756847/JAW.

A feasibility study is made on the application of secondary batteries to electric cars. The further extended use of electric cars requires development of high performance secondary battery that will substitute conventional lead storage batteries. Solution of economic and social problems are also needed to put in practice the battery replacing system and dual mode system for compensation of the short traveling distance per charging of secondary batteries. They may be introduced in a planned and policy-intensive manner by designating particular types and areas for trial. Performance required for secondary battery are caluculated for several car types. The business van, for example, requires the energy density of 95-120Wh/kg and running output density of 60Wh/kg. Five types of battery, e.g. lead, and nickel-iron, are pointed out to have high possibility of practical application and other five types, for example nickel-hydrogen, for long-term possibility. Their feasibility and tasks for development are examined. (55 figs, 46 tabs, 16 photos, 118 refs)

22267 **(NP—9770301) Process for estimating the internal dimensions of starter batteries.** Steffens, W. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Elektrotechnik). 15 Jul 1987. 134p. (In German). NTIS (US Sales Only), PC A07. Order Number DE89770301/JAW.

The aim of this work was to develop a state of charge indicator for starter batteries in vehicles (with internal combustion engines). The behaviour of starter batteries was first examined in different traffic conditions. Measurements were then made on the test rig on new and various old batteries, in order to determine the relationship of internal battery sizes on age, temperature, charging and discharging current, for example. An electrical equivalent circuit for describing the internal parameters of the battery was designed from these results, where deviations of this battery model from the actual battery were corrected by using the Kalman filter. The newly developed state of charge indicator was then explained using block circuit diagrams. Using this equipment, it is possible to switch off the generator, for example, if the battery is in the fully charged state (saving of power losses of more than 1 kW).

22268 **Electrochemical investigations of organodisulfides.** Liu, M.; Visco, S.J.; De Jonghe, L.C. (Materials and Chemical Sciences Div., Lawrence Berkeley Lab., and Dept. of Materials Science and Mineral Engineering, Univ. of California, Berkeley, CA (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

A group of organic disulfides have been recently introduced as positive electrodes for high-energy-density battery applications. The advantages of these compounds includes low operating temperature, high energy density, low cost, passive behavior to many materials, and low toxicity . Furthermore, their properties can easily be modified by appropriate choice of the organic groups. To date, however, the fundamental physical, chemical, and electrochemical properties of these materials have not been established. The purpose of this study is to investigate the redox behavior, chemical stability and reversibility, kinetic reversibility, and adsorption phenomena of organodisulfides at electrode surfaces.

22269 **Development of overcharge tolerance in Li/FeS and Li/FeS/sub 2/ cells.** Kaun, T.D.; Holifield, T.F.; Nigohosian, M.; Nelson, P.A. (Argonne National Lab., Chemical Technology Div., Argonne, IL (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

Li-alloy/FeS/sub x/ battery cells with molten electrolyte currently require an electronic charge/equalizer to protect the cells from destructive overcharging. The development of Li/FeS/sub x/ cells which are overcharge tolerant would allow the elimination of electronic safeguards and aid battery development, especially for a bipolar design. An earlier innovation provided cells that could be overcharged at full battery charge current for a finite capacity. The development to be reported on here is an additional unlimited trickle-charge tolerance. The mechanism behind the overcharge tolerance involves dependence upon a self-discharge rate controlled by the activity of the Li-alloy electrode. The proposed lithium-shuttle self-discharge mechanism involves (1) dissolution of Li at the Li-alloy electrode surface, (2) diffusion to across the separator to the positive electrode, and (3) discharge of the Li (possibly Li/sub 2// sup +/) to reduce the positive electrode capacity. The authors have investigated the controlling parameters of this mechanism, as well as operated compact prismatic cells to exhibit its effectiveness.

22270 **Effect of platinum catalyst distribution on the performance of solid polymer electrolyte fuel cells.** Ticianelli, E.A.; Beery, J.G.; Srinivasan, S. (Los Alamos National Lab., MS D429, Los Alamos, NM (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

One of the principal objectives of the Los Alamos fuel cell program is to develop high-power-density, solid-polymer-electrolyte fuel cell systems with electrodes containing a platinum loading of one tenth or less than that in state-of-the-art fuel cells. The essence of the approach used to attain this goal is to impregnate a proton conductor into a porous electrode containing only 0.4 mg/cm/sup 2/ of Pt and then to bond two of these electrodes to the proton conducting membrane. By using the standard 10-wt% Pt/C gas diffusion electrodes for preparing these membrane and electrode assemblies, a high power density (—0.3 W/cm/sup 2/)/sup 2/ is attained. However, to further increase the power densities, it was necessary to modify the electrode structure. This was achieved by using electrodes with a thinner electrocatalyst layer and by depositing a thin platinum film on the front surface. The morphologic characterization of these electrodes, using Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), and Rutherford Backscattering Spectrometry (RBS), carried out during the development of these electrodes is presented in this paper. The authors also explain how the performance of SPE fuel cells with low-platinum-loading electrodes is dependent on their morphologic characteristics.

22271 **Effect of R groups on Na/RSSR battery characteristics.** Visco, S.J.; DeJonghe, L.C. (Lawrence Berkeley Lab., Materials and Chemical Sciences Div., 1 Cyclotron Road, Berkeley, CA (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

Advanced secondary batteries operating at intermediate temperatures i.e. 100 to 200°C, have attracted considerable research interest due to their inherenet advantages over higher temperature systems such as the Na/S or Li/FeS/sub 2/ batteries. Current work in this laboratory has involved research on a novel class of intermediate temperature batteries based on a concept similar to the sodium beta-alumina/sulfur battery, but operating within the range of 100 to 150°C and having an organosulfur positive electrode. The organosulfur electrodes are based on the reversible electrochemical 2 electron reduction of the organo-disulfide to the corresponding thio anion, where R is an organic moiety. The oxidation of thiols to disulfides has been long established, but has not been considered previously in the context of energy conversion. The attraction of such a generic organic redox couple for battery research is the ability to tailor the physical, chemical, and to a lesser extent electrochemical properties of the molecule through choice of the organic moiety. The viscosity, liquidus range, dielectric constant, equivalent weight, and redox potential, of the organosulfur electrodes can in fact by varied in a predictable manner.

22272 **Bromine transport in zinc bromine battery separators.** McBreen, J. (Dept. of Applied Science, Brookhaven National Lab., Upton, NY (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

The zinc-bromine battery is attractive for load leveling applications. Here overall AC/AC efficiency is very important. Combined power conditioning and battery pumping losses are in the vicinity of 10%. So a high electrochemical efficiency is desirable. Major reduction in cell resistance are unlikely. Therefore, further improvements have to be in coulombic efficiency. Coulombic efficiency is largely determined by the transport of bromine species through the separator during cell operation and standby. Other sources of losses are shunt currents. The modes of transport through the separator are diffusion, migration and convective flow. In modeling zinc-bromine batteries certain assumptions have to be made about the diffusivities of various bromine species. The presence of bromine complexing agents may also affect the ratio of the species present. The present paper is about a simple method for determination of the relative contributions of diffusion and migration of bromine species through separators.

22273 **Lithium/disulfide cells capable of long cycle life.** Kaun, T.D.; Holifield, T.F.; De Luca, W.H. (Chemical Technology Div., Argonne National Lab., Argonne, IL (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

A Li/upper plateau (U.P.) FeS/sub 2/ battery has intrinsic high-performance characteristics: high theoretical specific energy (—500 Wh/kg) and achieved high power (200-300 W/kg). Earlier advances in the Li/U.P. FeS/sub 2/ cell with LiCl-LiBr-KBr electrolyte resulted in high performance and capacity stability. These advances enabled cells with 40% of theoretical specific energy to be realized through operation of high energy density electrodes. Now, lithium/disulfide cell tests have demonstrated a 1000 cycle-life capability. Development of overcharge and overdischarge tolerant battery cells has reinforced their durability. Therefore, the performance and durability of the lithium/disulfide battery are highly

suited to an electric van application. The results of a battery design study for the IDSEP Van are reported.

22274 **Chemical overcharge/overdischarge protection for Li-alloy/transition-metal monosulfide cells.** Redey, L. (Argonne National Lab., Chemical Technology Div., 9700 S. Cass Ave., Argonne, IL (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

The present lithium-alloy/metal sulfide cells require the careful monitoring of an experimentally established charge cutoff voltage limit to prevent overcharge of the cell. Maintaining the charge voltage at or below the voltage limit and simultaneously reaching equal capacity in each serially connected cell of a lithium/metal sulfide battery over many cycles are difficult tasks. To overcome this difficulty, a special integrated charger/battery system has been developed. Ideally, the cell/battery overcharge control, however, should rely on a built-in chemical mechanism that furnishes the cells with an inherent overcharge tolerance. For lithium-alloy/disulfide cells, chemical overcharge protection by a polysulfide shuttle mechanism has been proposed. This mechanism, however, is not available in monosulfide cells. For lithium-alloy/monosulfide cells, two phenomena suggest a possible method of chemical overcharge protection: dissolution of lithium from the negative electrode and the associated self-discharge of the cell.

22275 **A comparison of lithium ion conducting and divalent ion conducting polymer electrolytes in secondary solid state batteries.** Gilmour, A.; Munshi, M.Z.A.; Owens, B.B.; Smyrl, W.H. (Dept. of Chemical Engineering and Materials Science, Corrosion Research Center, Univ. of Minnesota, 221 Church St., SE, Minneapolis, MN (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

Complexes of polyethylene oxide (PEO), and lithium salts have been shown to be promising materials as the solid state polymer electrolyte element in the development of high energy lithium batteries. The present study was focussed on divalent metal systems that might offer the possibility of increased specific capacity or energy density. Magnesium is of particular interest because of its diagonal relationship in the periodic table with lithium. Recently, the solid magnesium perchlorate-PEO complex. (PEOδ:Mg(ClO/sub 4/)/sub 2/) has been shown to give conductivities between 10/sup -5/ and 10/sup -6/ S/cm at 80°C. This is comparable with that for lithium polymer electrolytes at similar temperatures. The cells studied in this laboratory, M/MX in PEON/V/sub 6/O/sub 13/ have been based on a divalent metal anode, a polymer-divalent salt electrolyte and a V/sub 6/C/sub 13/ composite cathode. The divalent metal systems being studied are based upon anodes of magnesium, calcium, zinc and copper. Cells of area 6.4 cm/sup 2/ have been cycled at constant current discharge and current limited constant voltage charge at various rates. Preliminary results indicate that the copper and zinc systems are reversible. Cycling data have been compared with those of the corresponding lithium systems.

22276 **Model for leakage current in a bipolar stack with separate electrode loops.** Wu, H.; Yang, M.Z.; Selman, J.R. (Dept. of Chemical Engineering, Illinois Institute of Technology, Chicago, IL (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

Several models predicting leakage current in a bipolar battery stack has been presented in recent years. The present work extends this by applying current balance and potential balance equations to a stack of cells with separators and with separate, possible asymmetric, electrolyte circulation loops for positive and negative electrodes. It treats the separate electrolyte loops and manifolds, as well as membrane or separator as resistance elements in an electric circuit analog. This results in a set of linear difference equations with constant coefficients. Difference calculus is then applied to solve the coefficients. Leakage currents in stacks made up of different numbers of cells are predicted and the effect of each resistance component on stack performance is investigated.

22277 **Thin film positive electrodes for lithium-iron sulfide batteries produced by atmospheric pressure chemical vapor deposition.** Petric, A.; Crouch-Baker, S.; Emerson, R.M.; Gur, T.M.; Huggins, R.A. (Dept. of Materials Science and Engineering, Stanford Univ., Stanford, CA (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

Thin films of FeS/sub x/($1 < x < 2$) have been produced by atmospheric pressure chemical vapor deposition (CVD). Their performance in a Li/FeS/sub x/ battery has been investigated at ambient temperature. The CVD apparatus consisted of an open tunnel furnace and an injector head with three concentric ports. The two reactive gases, H/sub 2/S and Fe/CO)/sub 5/, and a nitrogen separator gas were directed onto Mo or Al foil substrates which passed under the injector head on a moving conveyor belt. The temperature was varied from ambient to 400C. Nitrogen curtains were used to exclude air from the reaction zone. The composition of the films could be varied between FeS and FeS/sub 2/ by adjusting the flow ratio of the reactive gases. The deposition rate was found to vary linearly with both time and reactive gas flow rate. The thermodynamics of the cell reaction can be explained in terms of the ternary Li-Fe-S diagram. Some of the pertinent equilibrium potentials have been established at room temperature and are compared with previous work. The results of work with this thin film FeS/sub x/ cathode will be compared with those of other positive electrode materials.

22278 **Optical sensing of chemically induced strains.** pp 502-511 of Chemical sensors. Volume 87-9. Turner, D.R. Pennington, NJ; The Electrochemical Society (1987). (CONF-8710234—).

From Symposium on chemical sensors; Honolulu, HI, USA (18 Oct 1987).

Coated optical fibers in an optical interferometer configuration have been used to measure in situ and in real time the strains induced by chemical changes in the coatings. With a palladium coating this technique has been used to measure hydrogen gas concentrations between 10ppb and 2%. Using a metal coated fiber in an electrochemical cell, the strains induced during electrodeposition of palladium and nickel have been measured. Strains associated with the anodic oxidation of titanium have also been measured. The implications of this new technique for other chemical and electrochemical environments will be discussed.

29 ENERGY PLANNING AND POLICY

REFER ALSO TO CITATION(S) 21674, 21676, 21677

22279 **(CRIE-T—87049) Boiling heat transfer characteristics of narrow crevice of heat transfer tube. Relation between pressure and temperature fluctuation induced by dry and wet.** Kinoshita, Izumi; Kawamura, Takaharu. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jul 1988. 29p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756829/JAW.

In order to reveal the relation between the corrosion occurence at the heat transfer tubes of the steam generator and boiling phenomena at the narrow crevice which formed between the heat transfer tubes and the baffle plate, temperature flactuation caused by dry and wet were studied by changing the degree of subcooled boiling, heat flux, pressure and arrangement of the heat transfer tubes. Combinating a heat transfer tube, made of inconel, of 22.2mm in outside diameter with a baffle plate provided a through hole of 22.6mm in inside diameter, the tests were performed in the oil loope of 3atg, 320°C and the demineralized water loope of 10atg, 190°C. Under same pressure and heat flux, temperature fluc-

tuation at subcooled boiling were larger than one at saturated boiling, and did not depend on the degree of subcooling. For the eccentric arrangement of the heat transfer tube, peak of temperature fluctuation appeared at the range from 60° to 90° from contact point with the baffle plate. Dependence on temperature and pressure of the location were weak. (24 figs, 5 tabs, 1 ref)

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 22393, 22394, 23939

22280 **(AFME—86.91.0011.1) MINERG software for the assistance to energy diagnostic.** Brunet, R. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris; Centre Technique des Industries Mecaniques (CETIM), 93 - Saint-Ouen (France)). 1987. 505p. (In French). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88757215/JAW.

A computer code, called MINERG, had been up-dated and is presented in this article. It is specially adapted to industrial building energy evaluation; the following variables may be calculated: energy consumption (thermal and electric), energy-costs (taking into account the various price rate of gas, fuel, electricity, ...), energy per destination (industrial processes, space heating) and per industrial process etc. It takes into account the thermal inter-relation between machines and building envelope, the heat revovery, the solar gain, the stratification effect, the heat pumps, the price rate variation during the day, etc.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 22042, 22296, 22297, 22298, 22329, 23885

22281 **(CONF-890430—1) Problems in the economic evaluation of proposed projects in emerging energy technologies.** Williams, K.A. (Oak Ridge National Lab., TN (USA)). 1 Apr 1989. Contract AC05-84OR21400. 22p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008630/JAW.

From American Institute of Chemical Engineers spring national meeting; Houston, TX, USA (2 Apr 1989).

Historically, deterministic estimates of unit product or life-cycle costs made early in the R and D program tend to overstate performance and underestimate costs, even after adjusting the latter for inflation. Much of this misestimation can be attributed to design uncertainty caused by incomplete knowledge of the physics, chemistry, or engineering of the process or system. Developer optimism in picking values for key process design attributes and hardware costs is also a major factor. It is proposed that probabilistic multivariable risk/uncertainty analysis coupled with specially constructed process or system computer models can improve the quality of early cost projections. Such a model consists of parametric cost-scaling algorithms coupled to a phenomenological performance model of the process or system of interest. If properly constructed, this model essentially redesigns and re-estimates the process for any set of reasonable uncertain inputs. Guidelines are presented for constructing such models and performing risk/uncertainty analysis thereupon are presented. The treatment of special modeling and estimating problems encountered in particular DOE-funded energy-related technologies is discussed. 15 refs., 6 figs.

22282 **(PNL—6813) Hanford and the tri-cities economy: Review and outlook, March 1989.** Scott, M.J.; Belzer, D.B.; March, S.J.; Beck, D.M.; Schultz, R.W.; Harkreader, S.A. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1989. Contract AC06-76RL01830. 103p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008931/JAW.

The economy of the Tri-Cities, Washington area (primarily, Benton and Franklin Counties) is in transition due to major changes in two Department of Energy programs at Hanford—the abrupt ending of the Basalt Waste Isolation Project (BWIP) in December 1987 and the placing of the N Reactor in "cold standby" status in February 1988. This report reviews the economic situation in the Tri-Cities during 1988 and presents forecasts for key economic indicators for 1989. This report will be updated about every six months to review the changes in the area economy and forecast the near-term outlook. 6 figs., 33 tabs.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 21690, 21827, 21886, 22021, 22058, 22283, 23057, 23178

2904 Natural Resources

22283 **(DPAG—8712) Water in northern Alberta.** (DPA Group, Inc., Calgary, Alberta (Canada); W-E-R Engineering Ltd., Calgary, Alberta (Canada)). 1987. 109p. (MICROLOG—88-03411). Northern Alberta Development Council, Provincial Bldg., 2nd Floor, 9621-96th Ave., PO Bag 900-14, Peace River, AB, Canada T0H 2X0; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report contains background information, including historical aspects, roles of government agencies, and relevant technical information, for use as a resource document at a conference on water resources in northern Alberta. An overview is presented of the three river basins which are the geographic focus of this report (Peace River, Athabasca, and Beaver River), describing their characteristics, the types of human activity occurring in them, and the relevant issues pertaining to water. The roles and responsibilities of government departments and agencies in water management are then introduced. A section on water resource issues defines ten topic areas, and for each issue, a summary of the issue, background of the issue, and key concerns and suggested actions are given. These issue areas concern groundwater management (including protection from contamination by oil field produced water), community water supply, farmland drainage and erosion, protection of surface water quality, watershed and wetlands management, farm and rural water supply, tourism/recreation and fisheries, industrial water use (particularly by the oil sand, forestry, and hydroelectric power industries), native peoples' concerns, and water diversion. The final section discusses a number of common themes which arose from the public consultation process, including integrated planning and program coordination, monitoring and enforcement, public information, and research requirements. 22 refs., 8 figs., 3 tabs.

22284 **(NP—9770318) Annual report on the raw material situation 1986.** (Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (Germany, F.R.)). Jun 1987. 104p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89770318/JAW.

The total of raw materials used in the Federal Republic of Germany in 1986 is described in terms of domestic production, imports, price developments. Raw materials are broken down in petroleum and natural gas, hard coals, lignite, nuclear fuels, metal raw materials, non-metallic minerals and industrial minerals. The Federal Government's exploration support programme is described for the year 1986. Imports and exports of mineral raw materials are described in terms of countries and quantities. (MOS) With 1 separate map.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 21916, 21919, 21949, 21958, 22316, 22329, 22378, 22421, 22465, 22466

22285 **(DOE/CE/64615—T2-Vol.2) Developmental state program for institutional conservation: Volume 2: Final technical report, October 1, 1986--September 30, 1988.** (New Mexico Dept. of Energy, Minerals and Natural Resources, Santa Fe (USA)). 1988. Contract FG01-86CE64615. 386p. NTIS, PC A17 - OSTI. Order Number DE89009238/JAW.

The State of New Mexico has contracted with Frank Bolek and Associates to perform an Energy Audit (EA) for Animas Elementary and Animas High Schools, and to organize data at the

schools to assist the School District in Developing a Heating, Ventilating and Air Conditioning (HVAC) Preventive Maintenance (PM) program. The goal of both the EA and PM is to reduce energy consumption and operating costs of the schools.

22286 **(DOE/CE/64615—T2-Vol.4) Developmental state program for institutional conservation: Volume 4: Final technical report, 1 October 1986--30 September 1988.** (New Mexico Dept. of Energy, Minerals and Natural Resources, Santa Fe (USA)). 1988. Contract FG01-86CE64615. 381p. NTIS, PC A17 - OSTI. Order Number DE89009235/JAW.

This project is co-sponsored by the New Mexico Department of Education, the New Mexico School Administrators Association and the New Mexico School Boards Association. This report is intended to help you lower your utility bills by presenting specific actions to reduce energy use. The actions that were identified include Operations and Maintenance Procedures (O&Ms) and Energy Conservation Measures (ECMs).

22287 **(DOE/CE/64615—T2-Vol.5) Developmental state program for institutional conservation: Volume 5: Final technical report, 1 October 1986--30 September 1988.** (New Mexico Dept. of Energy, Minerals and Natural Resources, Santa Fe (USA)). 1988. Contract FG01-86CE64615. 242p. NTIS, PC A11 - OSTI. Order Number DE89009236/JAW.

This project is co-sponsored by the New Mexico Department of Education, the New Mexico School Administrators Association and the New Mexico School Boards Association. This report is intended to help you lower your utility bills by presenting specific actions to reduce energy use. The actions that were identified include Operations and Maintenance Procedures (O&Ms) and Energy Conservation Measures (ECMs).

22288 **(DOE/CE/64615—T2-Vol.6) Developmental state program for institutional conservation: Volume 6: Final technical report, 1 October 1986--30 September 1988.** (New Mexico Dept. of Energy, Minerals and Natural Resources, Santa Fe (USA)). 1988. Contract FG01-86CE64615. 202p. NTIS, PC A10 - OSTI. Order Number DE89009240/JAW.

This project is co-sponsored by the New Mexico Department of Education, the New Mexico School Administrators Association and the New Mexico School Boards Association. This report is intended to help you lower your utility bills by presenting specific actions to reduce energy use. The actions that were identified include Operations and Maintenance procedures (O&Ms) and Energy Conservation Measures (ECMs).

22289 **(DOE/CE/64615—T2-Vol.7) Developmental state program for institutional conservation: Volume 7: Final technical report, 1 October 1986--30 September 1988.** (New Mexico Dept. of Energy, Minerals and Natural Resources, Santa Fe (USA)). 1988. Contract FG01-86CE64615. 312p. NTIS, PC A14 - OSTI. Order Number DE89009241/JAW.

The state of New Mexico has contracted with Frank Bolek and Associates to perform an Energy Audit (EA) for San Jon Elementary and San Jon high School, and to organize data at the schools to assist the School District in developing a Heating, Ventilating and Air Conditioning (HVAC) Preventive Maintenance (PM) program. The goal of both the EA and PM is to reduce energy consumption and operating costs of the schools.

22290 **(DOE/CE/64615—T2-Vol.8) Developmental state program for institutional conservation: Volume 8: Final technical report, October 1, 1986--Septemeber 30, 1988.** (New Mexico Dept. of Energy, Minerals and Natural Resources, Santa Fe (USA)). 1988. Contract FG01-86CE64615. 196p. NTIS, PC A09 - OSTI. Order Number DE89009239/JAW.

This report contains three sections. The first section is Findings which evaluates the Santa Fe Public School's energy conservation efforts. The next two sections present the spreadsheet files that produced the information and that Santa Fe Public Schools will continue to use for monitoring.

22291 **(NEDOJ-OS—8742-Pt.2) Survey of development feasibility of technology concerning solar energy utilization in the south Pacific contries separate issue.** (New Energy and Industrial Technology Development Organization, Tokyo (Japan)). May 1988. 280p. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88756478/JAW.

In order to discover the feasibility of conducting the research and development for solar energy utilization technology including solar beam power generation jointly with countries in the South Pacific Ocean, such basic data as the current situation of demand and supply in these countries were collected, the potential of the solar energy utilization including solar beam power generation in these countries were analyzed and the feasibility and basic orientation of a joint research were studied in 1986 (basic survey) and 1987. This survey is an assembly of about 650 pieces of reference material obtained by both above surveys, and contains a list of reference material obtained from CRRERIS (Commonwealth Regional Renewable Energy Resources Information System), a list of reference material obtained from other than CRRERIS and a list of agencies and organizations related to energy in the South Pacific countries.

22292 **(NEDOJ-P—8714) Surveys on project management system and technology assessment performed for oil alternative energy technologies in USA (3).** (New Energy and Industrial Technology Development Organization, Tokyo (Japan)). Mar 1988. 375p. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88756484/JAW.

As a useful tool for managing the research and development projects to efficiently achieve the technical and cost targets, information and materials concerning Project Management System (PMS) were collected, systematically compiled and analyzed. The efforts were focused on Project Management System published by DOE. Furthermore, information and materials on PMS adopted by NASA and on research evaluation methodologies utilized by major OECD member countries were also summerized. Major findings include; delegation of the practical management responsibility to the personnel directly performing R and D activities, phased project management approach and executive decision making on proceeding to next phase, uniform documents on the project plan and the management plan, concrete quantitative management to the targets of technical performance, cost and schedule, timely fore -seeing necessity of the baseline change, establishing unique data base and work breakdown structure. The design of pilot system for NEDO's PMS was reviewed its basic frame and prepared draft guidance for operating PMS. (33 figs, 13 tabs)

22293 **(PNL-SA—16279) Putting science and technology to work: A casebook of transferred technologies.** (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 20p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009158/JAW.

New knowledge, processes, and products regularly emerge from federally funded research and development programs such as those at Pacific Northwest Laboratory (PNL). Through technology transfer, PNL shares the benefits of national investments in scientific progress with all segments of society. Technologies and technical capabilities developed for the US Department of Energy and other federal agencies are then put to work, applied to the needs of business, industry, and state and local government.

22294 **(SCBC—8804) The B.C. Science Council Energy Sectoral Planning Committee report.** (Science Council of British Columbia, Victoria (Canada)). 1988. 68p. (MICROLOG—88-04981). British Columbia Legislative Library, Government Documents Division, Parliament Buildings, Victoria, BC, Canada V8V 1X4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The energy sector of British Columbia is reviewed, with an examination of the province's energy sources, energy consumption, manpower training, environmental considerations, new technologies associated with energy such as superconductivity and fuel cells, and aspects of the management and planning for the future in energy

research. In the section on energy sources, a review of the present situation is briefly made, and new developments in exploration, production and transportation are investigated. Natural gas is suggested as an alternative transportation fuel. Recommendations are made for research into natural gas vehicles and engines, coal resources and coal convrsion. An energy research centre and stable, long-term financial support for energy research and development are also recommended. 5 figs., 2 tabs.

22295 **(UCID—20366-89) Engineering thrust areas, 1989.** (Lawrence Livermore National Lab., CA (USA)). 1989. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009009/JAW.

The mission of the Engineering Research Program is to develop the tools and technology needed to support current and future Laboratory programs. To accomplish this mission Engineering Research has two important goals - to identify key technology areas important to the Laboratory and to conduct high quality research and development in support of Engineering's and the Laboratory's mission. To help focus our efforts in achieving our goals we identify key technologies called thrust areas and select technical leaders in these technologies to lead each area. The thrust areas are an integrated Engineering activity and, rather than being primarily discipline based, are staffed by the research engineers from EE and ME and from other Laboratory organizations as appropriate. The thrust area leaders are accountable to me for the quality and progress of their research activities but have significant latitude to manage the resources allocated to their thrust area. They are expected to establish strong links to the Laboratory program leaders, to use outside as well as inside experts to review the quality and direction of the research, to use university contacts to supplement and complement their efforts, and to be certain that we are not duplicating the work of others. The thrust area leader is also responsible for carrying out the development work that follows from the Research program so that the results of the research can be applied as early as possible to the needs of the programs. This booklet contains capsule descriptions of the activities of each thrust area and illustrates how thrust area activities and technologies support Laboratory programs.

22296 **Integrating the development of innovative concepts into corporate strategy.** Smith, R.M. (Pacific Northwest Lab., Richland, WA (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889313.

Most good innovative ideas come from individuals who become creatively stimulated when they least expect it. The challenge is to convert these good ideas into marketable products. Most scientists contribute greatly to the advancement of technology often without considering that their discoveries may solve a market need. Better communication and understanding of marketing objectives and techniques is needed since the problem facing most large corporate executives is to convert fragmented developments into total market solutions. Several organization approaches have evolved in the management of technology designed to address the possibility of maximizing benefits from creative ideas, but two will be discussed in depth in this paper. The first internally directed method is to incorporate innovative ideas into the portfolio structure of strategic business units. The second externally directed method is to form a technology transfer operation which leads to new corporate or external spinoff ventures. Both of these approaches deal with the problems of cost and risk associated with the crucial step of commercialization, but in different ways.

22297 **Encouraging the initiation of invention/innovation.** Watts, R.L. (Pacific Northwest Lab., Richland, WA (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889312.

Uniquely successful methods of encouraging early stages of the invention/innovation process have been demonstrated by the Innovative Concepts Program (ICP). This program provides modest seed money and substantial non-financial assistance to overcome the environmental and cultural factors that retard or prevent scientists and engineers from formulating their ideas into innovative concepts and preparing them for presentation to potential sponsors. The ICP was initiated by the Office of Energy Utilization Research in the Department of Energy (DOE) five years ago to develop and demonstrate methods of turning research ideas into innovative concepts thus increasing the inventory of potential new program starts. The program is an "invention laboratory" harvesting potential breakthrough concepts to be considered for further development by other Federal programs and by industry. The ICP invention laboratory encourages the development of immature concepts fundamentally different from current practice having the potential for saving energy and increasing productivity.

22298 **Overview of the U.S. Dept. of Energy's Innovative Concepts Program.** Levinson, T.M. (Innovative Concepts Program, U.S. Dept. of Energy (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889311.

During the early 1980's the Department of Energy's (DOE) changed the emphasis of its energy conservation policy from demonstration programs to longer-range, higher-risk, higher-payoff generic research. At that time DOE's Office of Energy Utilization Research (EUR) perceived a need to increase the inventory of revolutionary concepts available for new program starts. The EUR realized that this would be much more difficult than looking for incremental improvements to existing technology. In 1981, in response to this policy change, the DOE initiated the Innovative Concepts Program (ICP) to develop and demonstrate methods to identify, select, and provide preliminary evaluations of revolutionary energy-saving concepts. Since that time, the ICP has been modestly increasing the inventory of concepts available for new program starts and developing methods for encouraging the formation of revolutionary new concepts. These concepts are presented to potential sponsors in industry/Government along with information for making follow-on funding decisions. In this role, the ICP complements two other DOE programs, the Energy-Related Inventions Program and the Small Business Innovation Research Program. This paper briefly discusses the ICP: its objectives, rationale, elements of the program, its history, accomplishments, and future plans.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 21836, 21852, 21876, 22058, 22073, 22107, 23049

22299 **(INIS-mf—11391) Country plan Zeeland, predesign. Official note reactions and answers.** (Provinciale Staten Zeeland, Middelburg (Netherlands)). Oct 1986. 93p. (In Dutch). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88706172/JAW.

In this official note of the steering committee Streekplanwerk (country plan work) the timely entered reactions on the predesign-country plan Zeeland, concerning the location of additional nuclear power plants in Borssele are elaborated. The relevance of the policy can be related to the character of the reactions on the predesign-country plan, as well as to the character of the answers and conclusions associated with them. The answers in this note may be important as explanations of the contents of the predesign-country plan. The remarks are arranged, summarized and answered as much as possible according to the arrangement of the predesign-country plan. By subject, in each case, first the corresponding reactions are summarized, next the reactions are answered. From the conclusions it appears if and to what extent reactions may give motivations for modifications in the predesign.

22300 **(INIS-mf—11393) Contra-expertise nuclear power.** Storm van Leeuwen, J.W.; Daey Ouwens, C.; Waas, T.J. van; Olthof, L. (CEEDATA, Chaam (Netherlands)). 30 Apr 1987. 75p. (In Dutch, English). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88706173/JAW.

Some aspects of nuclear power are enlightened which seem to be applicable for the set up of an energy policy up to the year 2050. The following questions stand central: which energy potential does nuclear power have mondially, what are the costs of electricity generated by nuclear power, to what amount can nuclear power contribute at most to the reduction of the carbon monoxide problem, what are the bottlenecks in the development. The potential turns out to be 1% of the total mondial energy consumption for LWR as well as breeder reactors. The contribution of the breeder reactors up to the year 2100 is determined by the available quantity of plutonium. The costs of electricity from LWRs, in the actual current throw-away cycles are calculated to be 14.8 (Dutch) cent/kWh and from a FBR 31.3 cent/kWh. These are mean values of a high and a low estimation. Some cost entries are neglected so that actual costs will be higher. The contribution to the reduction of carbon dioxide production can amount at most to 1% of the total emission. Bottlenecks are: breeder reactor, processing of irradiated fission fuel, recycling of uranium and plutonium, processing and final storage of nuclear waste, dismantling of nuclear power and processing plants, social impact of accidents and of a plutonium economy, economic risks caused by accidents, vulnerability for disorders and accidents, and the system-dynamical inertion of a system of breeder reactors. 127 refs.; 25 figs.; 3 tabs.

22301 **(INIS-XN—155) Decree-Law of 6 october 1988, no. 427. Emergency provisions on energy policy.** (International Atomic Energy Agency, Vienna (Austria)). 7 Oct 1988. 2p. (In Italian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706182/JAW.

Published in the Gazzetta officiale della Repubblica Italiana no. 236.

Following the negative results of referendums on nuclear energy held in Italy on 8 November 1987, this Decree-Law provides that construction of the Moltalto di Castro nuclear power plant should cease and that it should be converted to a multifuel/natural gas turbine power plant. (NEA).

22302 **(INIS-XN—156) Radiation Protection Ordinance - amendment of 26 September 1988.** (International Atomic Energy Agency, Vienna (Austria)). 26 Sep 1988. 1p. (In French). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706183/JAW.

The amendment of the Ordinance of 30 June 1976 concerns the new division of responsibilities for delivering licences for the use of radioactive substances and ionizing radiation. Until now, only the Federal Office of Public Health was competent for issuing such licences; henceforth, the Federal Energy Office shares this task. The amendment entered into force on 1 November 1988. (NEA).

22303 **(INIS-XN—157) Exchange of Notes of 25 July 1986 between Switzerland and the Federal Republic of Germany amending and supplementing the Agreement of 31 May 1978/15 February 1980 on protection against radiation in case of emergencies.** (International Atomic Energy Agency, Vienna (Austria)). 25 Mar 1988. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706184/JAW.

The Agreement provides that the Parties shall inform each other of any radioactive emergency occurring on their territory which might have harmful consequences for the other neighbouring country. This amendment which entered into force on 25 March 1988 extends the undertaking of both Parties to inform each other on events in their respective nuclear installations which might cause apprehension to the populations in border areas. (NEA).

22304 **(INIS-XN—158) Agreement between the Swiss Federal Council and the Government of the Federal Republic of Germany on Radiation Protection in case of emergency.** (International Atomic Energy Agency, Vienna (Austria)). 31 May 1978. 2p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706185/JAW.

Translated by Swiss authorities.

In view of the risk of radioactive contamination of air and water which might arise from the operation of nuclear installations and the transport of nuclear material, and also because the population in the neighbouring country might be affected, in particular in the case of international transport, both Parties have undertaken to take a number of measures to meet this contingency. They will inform each other in case of a radioactive emergency on their territory which is likely to have harmful consequences for the neighbouring country. An appropriate information system in charge of liaising will be set up in each country. Information in case of radioactive emergency must specify the nature and time of the occurrence, the locality, the importance, the physical and chemical characteristics as well as the type of transport of the radioactive emission. Indications on the planned protection measures must also be communicated. In case of emergency or as an exercise, each Party is authorised to send a liaison group to the other Party, which will contact the bodies competent for combating radioactive contamination. (NEA).

22305 **(INIS-XN—159) Radiation Protection Act promulgated on May 19, 1988, SFS 1988: 220.** (International Atomic Energy Agency, Vienna (Austria)). 25 May 1988. 12p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706186/JAW.

Translation by Swedish authorities.

This Act entered into force on 1 July 1988 and supersedes the previous Radiation Protection Act (SFS 1958: 110). The objective of the new Act is to protect humans, animals and the environment from the harmful effects of ionizing as well as non-ionizing radiation. As previously, the main responsibility for public radiation protection will rest with one central radiation protection authority. The general obligations with regard to radiation protection place a greater responsibility than in the past on persons carrying out activities involving radiation. The Act also contains rules governing decommissioning of technical equipment which could generate radiation. Basically, the same requirements still apply regarding licensing of activities involving ionizing radiation, with certain extensions covering, inter alia, also production and transportation of radioactive material. Under the Act, it is now possible to adjust the licensing and supervisory procedures to the level of danger of the radiation source and the need for adequate competence, etc., and finally, more effective supervision is provided for. (NEA).

22306 **(INIS-XN—160) Radiation Protection Ordinance promulgated on May 19, 1988, SFS 1988: 293.** (International Atomic Energy Agency, Vienna (Austria)). 2 Jun 1988. 6p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706187/JAW.

Translation by Swedish authorities.

This Ordinance entered into force on 1 July 1988 and replaced the previous Radiation Protection Ordinance (1958:652). It designates the Radiation Protection Authority as the central authority referred to in the 1988 Radiation Protection Act. The Government may, in accordance with the Act, refer certain powers to such a subordinate authority. The Ordinance provides, in particular, that some provisions of the Radiation Protection Act do not apply to radioactive material and technical equipment emitting only low-level radiation. (NEA).

22307 **(INIS-XN—161) 877-Royal Decree 1753/1987 of 25 November partly amending the Regulations on health protection against ionizing radiation, approved by Royal Decree 2519/1982 of 12 August.** (International Atomic Energy Agency, Vienna (Austria)). 15 Jan 1988. 8p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706188/JAW.

Published in the Boletin Oficial Espanol No. 13.

This Decree modifies the 1982 Royal Decree on Radiation Protection as a result of Spain's entry into the European Communi-

ty and its taking into account of EURATOM Radiation Protection Directives 80/836. The 1987 Decree amends relevant provisions of the 1982 Decree to reflect the basic safety standards of the EURATOM Directives concerning the types of activities which imply exposure, the justification and optimisation of exposure and the requirement that individual doses not exceed specified limits. The annual dose equivalent limits are set out in Annex II to the Decree while Annex III gives the annual limits of intake by inhalation and ingestion for workers and members of the public.

22308 **(INIS-XN—167) S.I. 1988 No. 1353, The Food Protection (Emergency Prohibitions) Amendment No. 2 Order 1988.** (International Atomic Energy Agency, Vienna (Austria)). 29 Jul 1988. 4p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706194/JAW.

On 1 August 1988, The Food Protection (Emergency Prohibitions) Amendment No. 2 Order 1988 came into force. This Order updates the Food Protection (Emergency Prohibitions) Order 1988 by revising the prohibitions concerning the movement and slaughter of certain sheep, due to radioactive contamination from the Chernobyl accident. (NEA).

22309 **(SG-P—80) Nuclear power: necessity or self-interest?.** (Landbouwuniversiteit, Wageningen (Netherlands). Studium Generale). 1986. 62p. (In Dutch). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88706275/JAW.

In part one of this document a survey is presented, via a number of articles, of the power balances in the Netherlands with respect to nuclear power, the role of various institutions and concerns therein and the consequences of the parliamental decision-making in the Netherlands. In part two the development of nuclear power in the third world is explained by means of some examples, the interests of Western industrial countries in the stimulation of nuclear power in the developing countries and the power structures in these countries which play a role with respect to the atom lobby. Part three starts the discussion on the strategy to be followed by the Anti Nuclear Power movement with three strategies for resistance against the building of new nuclear power plants: via the parliamentary route, by means of direct action (base groups), by combining direct action with broadening and actions against supply industries. 59 refs.; 41 figs.; 6 tabs.

22310 **(SKN—29) Ethical aspects on nuclear waste. Some salient points discussed at a seminar on ethical action in the face of uncertainty in Stockholm, Sweden, September 8-9, 1987.** (Consultative Committee for Nuclear Waste Management (KASAM), Stockholm (Sweden); National Board for Spent Nuclear Fuel, Stockholm (Sweden)). Apr 1988. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757391/JAW.

This is the translation of the outline of some salient points at the seminar in Swedish published in KASAM's annual report 1987. The chapters are as follows: Starting points; Different types of uncertainty - mankind's built-in limitations - Uncertainty about society's development - Uncertainty about environmental development; Systems that diminish uncertainty; Risk; The shifting of paradigms in ethics; Our responsibility - The responsibility of coming generations- The needs for controls. (HSCH).

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 21726

2910 Conservation

REFER ALSO TO CITATION(S) 22285, 22286, 22287, 22288, 22289, 22290, 22324, 22365, 22371, 22414, 23889

22311 **(DOE/CE/64615—T2-Vol.1) Developmental state programs for institutional conservation programs: Volume 1: Final technical report, October 1, 1986--September 30, 1988.** (New Mexico Dept. of Energy, Minerals and Natural Resources, Santa Fe (USA)). 1988. Contract FG01-86CE64615. 112p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009237/JAW.

In 1986, the New Mexico Energy, Minerals and Natural Resources Department (EMNRD) proposed to the US Department of Energy (DOE) to develop and implement an innovative program to increase energy efficiency in the institutional building sector. EMNRD submitted this proposal to DOE in response to DOE Solicitation No. PS01-86CE64606, "Developmental State Programs for Institutional Conservation." The proposal provided for a variety of energy efficiency services to be provided to small, rural public school districts in New Mexico. This group of institutions historically had one of the lowest participation rates in energy conservation programs in New Mexico. Typically, these institutions had limited resources available to become involved in such activities. This report describes the activities that were conducted under DOE Grant No. FG01-86CE64615 by EMNRD. This report consists of eight volumes and a separate executive summary. This volume describes the project.

22312 **(NP—9770325) Location of measuring points for an information system for energy management in industrial concerns - development of an OR model with a proposal for a solution.** Boos, J. (Koeln Univ. (Germany, F.R.). Seminar fuer Fertigungswirtschaft). 1986. 92p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89770325/JAW.

On the basis of this comprehensive analysis, whose results can be shown in energy flow diagrams or energy balance summaries, an additional need arises for detailed information on the energy supply situations in individual in-plant areas. It is this collection of detailed information, however, that has been neglected in the past, since both the organisational and measuring facilities in plants have often been inadequate. A data acquisition system set up in this way provides the actual data of industrial energy management. The contrast of the actual data with the forecast data for energy distribution, as determined by the responsible engineers, leads to a precise control of the energy consumption and allows weak points in the plant's energy use to be located, so that they can be removed and thus successful savings effected. A further possibility exists, which is to use the actual data collected in the plant's cost accounting. In the collection and succeeding evaluation of energy consumption quantities in the individual production areas, an instrument is available for arriving at a precise knowledge of present energy-specific cost details at the points of consumption. In addition a basis is created for the achievement of a sufficiently precise consideration of product-specific energy consumption in share cost calculation. The installation of an information system is therefore a prerequisite for doing justice to the increased significance of the energy factor even in cost accounting.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 21671, 21678, 21715, 21725, 21932, 22324, 22339, 22466

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 21827, 21836, 21886, 22074, 22339, 22466, 23178, 23775

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 21615, 21625, 21625, 21629, 21650, 21651, 21652, 21671, 21671, 21671, 21672, 21674, 21675, 21676, 21677, 21678, 21679, 21692, 21692, 21695, 21699, 21711, 21711, 21712, 21713, 21714, 21715, 21726, 21728, 21730, 21731, 22294, 22323, 23057

22313 **(DOE/EIA—0484(89)) International energy outlook, 1989: Projections to 2000.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 8 Mar 1989. 62p. NTIS, PC A04/MF A01 - GPO - OSTI; 1; GPO Dep. Order Number DE89008380/JAW.

This report presents the current Energy Information Administration (EIA) assessment of the long-term outlook for international energy markets. It is provided as a statistical service for use by managers and international energy analysts and not as a government energy plan. It emphasizes oil market developments, particularly future world oil prices and oil production potential. The analysis recognizes that the development of alternative energy sources impacts directly on the world oil market. The world oil price projections developed in this international setting are used as assumptions for analyses of the US domestic energy market. Since the US energy market affects and is affected by the international market, the methodology incorporates this interaction to the extent possible.

22314 **(DOE/FE—0116) Strategic Petroleum Reserve annual/quarterly report.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of Petroleum Reserves). 16 Feb 1989. 54p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008846/JAW.

Section 165 of the Energy Policy and Conservation Act of 1975, as amended, requires the Secretary of Energy to submit annual and quarterly reports to the President and the Congress on activities to develop the Strategic Petroleum Reserve. Additional prospective information related to the development and fill of the Strategic Petroleum Reserve is required by the Omnibus Budget Reconciliation Act of 1986. This report combines the fourth quarter 1988 Quarterly Report with the 1988 Annual Report. Topics addressed include: storage facilities development; oil acquisition and transportation; budget and finance; drawdown and distribution system and vulnerability impact; other project activities.

22315 **(DOE/FE—0125) Clean Coal Technology Demonstration Program: Annual report to Congress (as of December 31, 1988).** (USDOE Assistant Secretary for Fossil Energy, Washington, DC). Feb 1989. 206p. NTIS, PC A10/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009636/JAW.

The Clean Coal Technology Demonstration program is a technology development program jointly funded by government and industry. It will take the most promising of the advanced coal-based technologies and, over the next decade, move them into the commercial marketplace through demonstration. These demonstrations will be at a scale large enough to generate data (from design, construction, and operation) necessary for the private sector to judge commercial potential and to make informed and confident decisions on commercial readiness. The programs are briefly described.

22316 **Overview of DOE's fossil energy international activities.** Greenbaum, M.A. (U.S. Dept. of Energy (US)). pp v of Proceedings of the fifth annual international Pittsburgh coal conference. Pittsburgh, PA; University of Pittsburgh (1988). (CONF-880915—).

From 5. annual international Pittsburgh coal conference; Pittsburgh, PA, USA (12 Sep 1988).

International cooperation in energy R and D between the United States and other countries certainly predates the energy crisis of the 1970's and the establishment of the U.S. Department of Energy. As world energy awareness intensified during the 1970's, the DOE was created and became the agency responsible for the majority of U.S. international energy activities. Within the DOE, the Office of Fossil Energy is the principal coordinator of fossil energy international activities which include not only coal programs, but also oil, gas and shale R and D. In this paper, several case examples, are presented showing just how the U.S. benefits from international R and D collaboration projects and emphasizing the increasing contribution of this program to both the U.S. economy and energy security. U.S. energy policy encourages effective international collaboration in Ra and D focusing on opportunities to enhance the competitiveness of U.S. technology and industry and to improve long-term national energy security. Furthermore, the U.S. government is actively encouraging the long-term reduction of U.S. and international dependence on oil by supporting research which could lead to the development and substitution of other energy forms.

22317 **Leveraging coal exports with technology.** Swink, D.F. (U.S. Dept. of Energy, Fossil Energy, Washington, DC (US)). pp v of Proceedings of the fifth annual international Pittsburgh coal conference. Pittsburgh, PA; University of Pittsburgh (1988). (CONF-880915—).

From 5. annual international Pittsburgh coal conference; Pittsburgh, PA, USA (12 Sep 1988).

The U.S. Department of Energy (DOE) is actively pursuing a program promoting U.S. coal exports. This program has been an outgrowth of the Presidential Energy Security Study of March 1987 and the National Coal Council's study on the competitiveness of coal completed in late summer 1987. Coal offers significant opportunity for energy security, improved balance of trade, and reduced consumption of imported oil. A key element of this program is leveraging coal exports with technology -- a concept new to the U.S. government and industry. The evolution of this program grew from historical developments in international coal markets. Energy demand forecasts predict significant growth in world coal consumption and for steam coal in particular. The Energy Information Administration recently projected that the sale of coal on the international market would expand from nearly 370 million tons in 1986 to more than 500 million tons by 2000. DOE believes that the U.S. can be a serious competitor in world coal markets, and we are supporting a change in America's coal expert policy. U.S. coal expert policy is evolving from a passive, somewhat "hands off" approach for the government to one that is more aggressive, more action oriented.

22318 **International coal research and development cooperation.** Siegel, J.S. (U.S. Dept. of Energy, Office of Fossil Energy, FE-20, 1000 Independence Avenue, S.W., Washington, DC (US)). pp 1075-1084 of Proceedings of the fifth annual international Pittsburgh coal conference. Pittsburgh, PA; University of Pittsburgh (1988). (CONF-880915—).

From 5. annual international Pittsburgh coal conference; Pittsburgh, PA, USA (12 Sep 1988).

International activities within the Office of Coal Technology are a fundamental part of the efforts to ensure that U.S. Industry remains technologically competitive in an evolving global market and to strengthen U.S. competitiveness in U.S. coal exports and coal technologies. The expectation that the free world's consumption of coal will continue to increase was illustrated in the Department of Energy's recent Report to the President on Energy Security. As the study stated, "Worldwide coal consumption is expected to show substantial additional growth before the end of the century, primarily because of increasing coal-fired electric generating capacity. World coal trade is expected to expand by almost 50 percent by 2000. The Energy Security study projects that European demand for coal could expand by 30 percent by the end of the century, with the largest tonnage increase taking place in Germany and Italy. Along the Pacific Rim, Japan's consumption of coal is expected to increase by 50 percent at the end of the century, based entirely on growing demand for steam coal. South Korea and Taiwan are also expected to become fast-growing steam coal importers, and South Korea is also increasing metallurgical coal im-

ports. To realize these large increases in the worldwide use of coal, a number of hurdles must be maneuvered. In many countries, the siting of new powerplants is being restricted because of land availability constraints or because of concern over potential environmental, health, and safety impacts. At the same time, most countries throughout the world are becoming more sensitive to the need to further protect the environment. Thus, environmental requirements are becoming more and more stringent. Additionally, in some countries coal transport is limited and, therefore, efficient energy systems to use the coal at mine-mouth or near ports and transport the coal by wire via electricity are required.

2960 Electric Power

REFER ALSO TO CITATION(S) 21962, 21971, 21972, 21973, 22006, 22007, 22257, 22294, 22324, 22325, 22365

22319 **(CONF-890196—1) A nonalgorithmic review of uncertainty in electric-utility resource planning and decision making.** Hirst, E. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 19p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009108/JAW.

From Stanford workshop; Stanford, CA, USA (21 Jan 1989).

Uncertainty is a critical factor that pervades all aspects of electric-utility planning. Uncertainties about future growth; about the continued performance of existing supply and demand resources; and about the costs, construction times, and operations of new resources greatly complicate utility resource acquisition. This paper discusses the integrated-resource planning process that many utilities now use to address uncertainty, reviews the methods that utilities use in planning and in acquiring resources, and suggests future research to help deal with uncertainties. This review is based on assessments of the long-term resource plans prepared by ten utilities and one Public Service Commission, telephone interviews with staff at these 11 organizations and with staff at three consulting firms, and reviews of other related publications. 15 refs., 2 figs., 4 tabs.

22320 **(DOE/CE/27473—T1) Report on Colorado electric power options study: Phase 1.** Etter, C.L.; Neil, C. (RCG/Hagler, Bailly and Co., Inc., Boulder, CO (USA)). [1989]. Contract FG01-87CE27473. 107p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009122/JAW.

The first phase of the CEPOS (CEPOS-1) should be viewed as a small first step in investigating the possibilities of least cost, or integrated, utility planning in the state. As such, it did not attempt to develop final conclusions or recommendations; instead, CEPOS-1 provides necessary background information and attempts to raise questions, opportunities and issues for future, more detailed study. Little technical analysis of the data was performed---such analysis would need to be done in subsequent phases of the total study. The approach used for CEPOS-1 was to identify and collect information in the public record, and to solicit additional information directly from the electric utilities in the state of Colorado, as well as from electric utilities in neighboring states. The collected information was then reviewed and analyzed by members of the project team with expertise in particular areas. The areas of focus were: current and future supply, future demand, transmission facilities, cogeneration and small power production, conservation and demand-side management, and the overall planning process. The focus of the analyses of the specific areas was on the current situation, the currently forecasted future situation, and alternative future situations that might be achievable. Once the analyses by project team members were completed, the analyses were combined to provide a broad state-wide perspective on the future for electricity demand and supply in the state. Concurrent with the other analyses, barriers to the achievement of possible future situations were identified, along with possible ways to remove or mitigate the barriers.

22321 **(LBL—21056) Utility overview study report, FY 1985: Regional indicators of potential for electric utility demand-side management programs.** Yen-Wood, W.; Kahn, E.; Levine, M. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008833/JAW.

The advent of increasing marginal costs and slower growth in the 1970's along with a proactive regulatory environment have spurred utilities to explore alternatives to traditional planning methods. Key factors that affected the industry were the failure of expected high demand growth to materialize, rapid increase in construction costs, the emergence of environmental concerns relative to generation and transmission facilities, increases in worldwide price of fossil-fuels, conservation legislation, and problems in the nuclear power industry. Both "Least-Cost Planning" and "Demand-Side Management" represent utility efforts to improve system efficiency through closer matching of electricity supply and demand. Among utilities, Least-Cost Planning is a strategic resource planning concept which compares the cost/benefit of "demand-reducing" and "capacity enhancing" options to that of constructing new power plants. Demand-side management involves development of end-use programs to influence the expected load shape. A central concern for analysts engaged in these activities is how to integrate the consumer's energy service needs with the utilities' system requirements so as to optimize "quality, reliability, and stable electricity prices". In this context, the primary objectives of the Utility Overview Study are to: Provide an estimate of where and when utilities are likely to be interested in promoting energy conservation as an alternative to energy exchange arrangements or construction of new plants to meet future energy demand; provide a framework for relating the conclusions of LBL utility case studies on financial impacts of energy conservation to the national context. 30 refs., 6 figs., 5 tabs.

22322 **(MH—1988) The Manitoba Hydro-Electric Board, thirty-seventh annual report for the year ended March 31, 1988.** (Manitoba Hydro, Winnipeg (Canada)). 1988. 42p. (MICROLOG—88-05429). Manitoba Hydro, PO Box 815, Winnipeg, MB, Canada R3C 2P4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A report is presented of the year's activities of the corporation responsible for supplying electric power to Manitoba. The corporation serves all areas of the province except central Winnipeg, and its 11 generating stations have a capability of nearly 4 million kW, of which ca 3.5 millon kW is hydraulic. The various sections of the report present information on customer services; electricity generated, purchased, and exported; system development, including construction of new power plants; research and development; personnel policies; and water management. Financial statements are also provided. Highlights of the year include: substantial progress on the Limestone generating station; a 25% drop in hydroelectric production due to reduced water flows resulting from drought; a 270-km transmission line completed to supply the Town of Churchill; and a sale of firm power to Ontario Hydro for the period 1998-2003. 21 figs., 3 tabs.

22323 **(NSBCPU—1988) [The Nova Scotia Board of Commissioners of Public Utilities] Annual report for the year ended December 31, 1986.** (Nova Scotia Board of Commissions of Public Utilities, Halifax (Canada)). 1988. 44p. (MICROLOG—88-04818). Nova Scotia Legislative Library, PO Box 396, Halifax, NS, Canada B3J 2P8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In addition to its responsibilities in regulating public utilities, the Nova Scotia board whose annual activities are summarized in this report also administers legislative acts relating to gasoline and fuel oil licensing, motor carriers, motor vehicle transport, and salvage yards. In addition, the Board performs special functions under other acts such as the Insurance Act. Information is presented on electric power production and consumption, amendments to rates, telephone services and decisions on rates, decisions on water services, fuel sales and license decisions, motor carrier and freight carri-

er license decisions, and salvage yard licensing. Financial statements are also included. 6 figs.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 21671

22324 **(EPRI-CU—6294) 1987 Survey of commercial-sector demand-side management programs: Final report.** Blevins, R.P.; Miller, B.A. (Electric Power Research Inst., Palo Alto, CA (USA); Battelle Columbus Div., Mount Pleasant, PA (USA)). Mar 1989. 232p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

The commercial sector represents a wealth of demand-side management (DSM) opportunities for electric utilities. This report, which provides the results of a survey that identified and collected descriptive information on commercial-sector DSM activities, can help utilities tap these opportunities. The survey provides summary information on 343 separate commercial programs conducted by 168 electric utilities. These programs reflect a diversity of utility objectives, technological focuses, incentive structures, market implementation techniques, and targeted customer types, and offer valuable sources of reference to utility planners. 26 figs., 40 tabs.

22325 **(EPRI-EM—5908) Residential customer preference and behavior: Market segmentation using CLASSIFY{trademark}: Final report.** (Electric Power Research Inst., Palo Alto, CA (USA); National Analysts, Inc., Philadelphia, PA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA); QEI, Inc., Davis, CA (USA)). Mar 1989. 41p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

This guidebook introduces and defines energy needs-based market segmentation for the residential electric utility customer market. It provides an overview of the segmentation technique used in the Customer Preference and Behavior (CP and B) project, describes the software (CLASSIFY{trademark}) that was created to help electric utilities segment residential customer markets based on energy needs, and offers several practical utility-specific examples of needs-based segmentation. Finally, it describes the application of needs-based segmentation in a utility's own service territory. 28 figs.

22326 **(NEDOJ-P—8724) Enquete and hearing survey on-energy consumption in residential sector.** (New Energy and Industrial Technology Development Organization, Tokyo (Japan)). May 1988. 198p. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88756487/JAW.

An enquete-investigation on the energy consumption in the residential sector which is closely related with the life of the people was carried out, and data in the past studies concerning to this point were also collected and studied. The consumption structure of household energy correspond to the changing life style was analysed in the six cities such as Tokyo, Osaka and so on. Average specific annual energy consumption amounts to 10,567 Mcal/Y,F (per year, per family) in which electricity shares 26.1 %, towngas 46.9 %, kerosine 24.6 % and so on. By usage, heating shares 3,787 Mcal/Y,F (35.8 %), hot water 34.3 %. These are the two large consuming purposes for energy consumption. By area, Sapporo's annual specific energy consumption per family is by far the highest with 20,269 Mcal and most of them namely 76.9 % is covered by kerosine for heating purpose. Results of this research evaluated by comparing the value of the specific energy consumption in the residential sector calculated by the enquete-investigation with the values derived from the past similar researches. (110 figs, 32 tabs, 38 rofs)

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 21715, 21932, 22294, 22378

22327 **(DOE/CE/27480—T1) Manual for evaluation: Ten steps to cost-effective renewable resource development in the electric utility sector.** (Renewable Energy Inst., Washington, DC (USA)). Sep 1988. Contract FG01-87CE27480. 56p. The Renewable Energy Institute, 1001 Connecticut Avenue, N.W., Washington, DC 20036.

This report is the product of extensive research, an intensive two-day workshop, and review and comment from experts in the fields of renewable energy and utility economics. The Manual for Evaluation project received funding support from the US Department of Energy, Least Cost Utility Planning Program, and the Tennessee Valley Authority. Workshop participants and project advisors made substantial in-kind contributions to the research effort. 27 figs.

22328 **(FIZ-P—2/2) Citizens' information on new energy technologies (BINE). Specialized information on new, non-nuclear energy sources and technologies. Final report.** (Fachinformationszentrum Energie, Physik, Mathematik G.m.b.H., Eggenstein-Leopoldshafen (Germany, F.R.)). 14 Sep 1988. 17p. (In German). Fachinformationszentrum Karlsruhe, Gesellschaft fuer Wissenschaftlich-Technische Information m.b.H., Eggenstein-Leopoldshafen (Germany, F.R.).

The BINE Information Service has been in existence since 1981 and was set up as a project within the Fachinformationszentrum Energie, Physik, Mathematik GmbH, Karlsruhe, to be an energy-political answer to the many questions put by citizens to the Federal Minister for Research and Technology (BMFT) on the subject of effective energy conservation and the use of renewable energy sources. An extension of the subject matter to include replenishable raw materials and the environment has been going on since 1.1.87, in line with current research topies. Since that time the Information Service has been called Citizen Information: New Energy Technologies, Replenishable Raw Materials, Environment. The questions from users show a desire on the public's part for unbiassed, easily comprehensible and yet technically based information. On this basis the research results are documented, processed and disseminated. BINE users are potential users of energy technology, people with a general interest and people who have a professional interest in the subject. The application-oriented processing and early publication of results from research and development projects of the BMFT can be regarded as an innovatory contribution. The present study reports in detail on the development and distribution of this information service.

22329 **Biofuels and municipal solid waste.** Walter, D.K.; Wallace, C.J. (U.S. Dept. of Energy, Washington, DC (US); Solar Energy Research Inst., Golden, CO (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889359.

Biomass currently contributes about 4% (1.3 million BOE/day) of the total annual U.S. energy requirement primarily in the form of residential heat, process heat and steam, and electricity from combustion of wood and municipal waste. Ethanol from grain crops contributes about 800 million gal/yr. to the transportation sector. These contributions from biomass are significant; however, the potential exists for a much greater impact on U.S. energy supplies in the post-2000 time frame. The achievement of this potential would help meet DOE's goal of a safe, secure, and affordable supply of energy. The Biofuels and Municipal Waste Technology Division's (BMWTD) strategy for contributing to energy security focuses on R and D where the risks are too tenuous for the private sector to assume alone, the transfer of the technology base to industry for demonstration and commercialization, and the involvement of industry in all stages of the federal research program. This paper addresses an overview of the BMWTD program with emphasis on

the strategic approach and implementation plan designed to help meet the Department's long-term goal.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

REFER ALSO TO CITATION(S) 21641

22330 **Technical issues and recent advances in MHD bottoming cycle development.** Swift, W.M.; Berry, G.F. (Argonne National Lab., Argonne, IL (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889372.

Although the technical development of the bottoming cycle for an open cycle MHD plant has made considerable advancement in recent years, a number of technical issues remain that still need to be addressed and resolved. Several of these issues are discussed and reviewed in this paper in light of recent experimental and modeling activities at Argonne National Laboratory and at the Coal-Fired Flow Facility operated by the University of Tennessee Space Institute. The major design issues considered within the scope of this review include the enhancement of radiant heat transfer in MHD combustion gases caused by potassium atoms and the presence of small slag particles, fouling of the convective passes, the interface of the bottoming cycle with the MHD topping cycle, NO/sub x/, decomposition in the radiant boiler, seed recovery and regeneration, and corrosion of materials of construction.

22331 **Coal-fired MHD topping cycle hardware and test progress at the component development and integration facility.** Burkhart, T.; Funk, G.; Glovan, R.; Hart, A.; Herbst, A.; Joyce, J.; Lee, Y.M.; Lundberg, S.; Stepan, I. (MSE, Inc., Butte, MT (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889369.

The Component Development and Integration Facility (CDIF) is a Department of Energy test facility operated by MSE, Inc. MSE personnel are responsible for the integration of topping cycle components for the national coal-fired magnetohydrodynamics (MHD) development program. Initial facility checkout and baseline data generation testing at the CDIF utilized a 50-MW/sub t/, oil-fired combustor (with ash injection to simulate coal slag carryover) coupled to the 1A supersonic channel. In the fall of 1984, a 50-MW/sub t/, pressurized, slag rejecting coal-fired combustor (CFC) replaced the oil-fired combustor in the test train. Other modifications affecting the performance of the CDIF test train included modifications to the CFC, the two 1A channels, and the various special wall sections that make up the channels. The special channel wall sections include a refurbished, platinum-capped anode wall; forward, peg-style sidewalls; newly designed and fabricated cathode walls; and diagonal sidewalls refurbished with newly designed and fabricated cathode sidebars. In addition, significant progress and developments were made on the CDIF dry material transport and measurement systems, including the dry iron oxide and iron oxide/oil slurry injection systems, the seed particle size reduction experiments, the dielectric-type densitometers, optical attenuation densitometers, and a differential pressure mass-flow device.

22332 **System analysis of high performance MHD systems.** Chang, S.L.; Berry, G.F.; Hu, N. (Energy and Environmental Systems Div., Argonne National Lab., Argonne, IL (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889370.

This paper presents the results of an investigation on the upper ranges of performance that an MHD power plant using advanced technology assumptions might achieve and a parametric study on the key variables affecting this high performance. To simulate a high performance MHD power plant and conduct a parametric study, the Systems Analysis Language Translator (SALT) code developed at Argonne National Laboratory was used. The parametric study results indicate that the overall efficiency of an MHD power plant can be further increased subject to the improvement of some key variables such as, the MHD generator inverter efficiency, channel electrical loading factor, magnetic field strength, preheated air temperature, and combustor heat loss. In an optimization calculation, the simulated high performance MHD power plant using advanced technology assumptions can attain an ultra high overall efficiency, exceeding 62%.

22333 **Bench scale evaluation of formate process based MHD seed reprocessing option.** Sheth, A.C.; Holt, J.K.; Rasnake, D.G.; Solomon, R.L.; Wilson, G.L. (Univ. of Tennessee Space Inst., Tullahoma, TN (US); Resources Conservation Co., Bellevue, WA (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889373.

Coal-fired, open-cycle magnetohydrodynamics (MHD) power plants have higher efficiency than conventional power plants. They use potassium salts in a sulfur-free form to increase the electrical conductivity of the plasma and to remove SO/sub 2/ from the gaseous effluent. For economic and environmental reasons the spent seed collected predominantly as K/sub 2/SO/sub 4/ needs to be desulfurized and recycled. In the absence of a suitable technology for recovering and recycling 90% of the potassium in a sulfur-free form to an MDH combustor, the U.S. Department of Energy, Pittsburgh Energy Technology Center (DOE/PETC) selected the team of the University of Tennessee Space Institute (UTSI) and Resource Conservation Co. (RCC) to perform necessary bench scale experiments to assess the potential of the Formate Process based seed reprocessing concept. Major results from the bench scale evaluations completed to date by the team of UTSI and RCC are presented in this paper.

22334 **Ionic diffusion in slag under MHD test conditions.** Lohrasbi, J.; Pollina, R.J. (MSE, Inc., Butte, MT (US); Bozeman, MT (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889374.

A theoretical analysis of diffusion times related to mass transfer of ions in MHD channel slag layers is presented in this paper. This analysis is relevant to establishing the criteria for reaching equilibrium slag composition under current MHD test conditions. Diffusion coefficients for important charge-carrying ions in the MHD environment were estimated, then the diffusion equation was solved in a dimensionless form using the Gaussian elimination method for the two most important ions: potassium and iron. Results show that in the absence of transverse electric fields it takes 163 hours to reach 90% of the equilibrium seed level in 90% of the slag layer and considerably longer for iron to penetrate to that extent. By contrast, locally heated hotspots caused by current concentrations in the slag layer on electrode walls take approximately 20 minutes to reach the same level of penetration.

3003 Thermoelectric Generators

22335 (NEDOJ-P—8708) Technical feasibility study on the development of ceramic thermoelectric conversion (Part 2). (New Energy and Industrial Technology Development Organization, Tokyo (Japan)). May 1988. 78p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88756481/JAW.

A survey was conducted on the current trends and problems with ceramic thermoelectric conversion, which converts thermal energy directly to the electric energy. The conversion efficiency of 19% and the output density of more than 0.5W/cm^2 have been accomplished in the laboratory. A possible application is the space power source. The Jet Propulsion Laboratory has been conducting the conceptual design. Present tasks include the development of electrodes with high output density and durability and construction of modular structures. The Ford has developed a 100 W class module with 6 single cells, which is under testing. The application of ceramic thermoelectric conversion will be widely advanced and the R and D will be accelerated when its advantages are demonstrated with modular structures in aspects of meeting the diversified energy needs and developing clean energy source. (66 figs, 15 tabs, 49 refs)

3005 Fuel Cells

REFER ALSO TO CITATION(S) 22263

22336 (CRIE-T—87044) Study of the pressurized operation of MCFC. Effects of methanation on the cell performance. Jingo, Naoki; Izaki, Yoshinori; Watanabe, Takao; Urushibata, Hiroaki. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jul 1988. 37p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756828/JAW.

In order to clarify the problems, such as methanation at the anode arised in thecase of pressurized operation of the molten carbonate fuel cell (MCFC), the effects of methanation upon the cell potential under the pressurized operation were studied from dry-based exhaust gas compositions. Under the pressurized operating conditions for the cell, effective gas components for power generation were declined due to the methanation, which suppresses the improvements of the cell potential, caused by H_2 and Co components of the fuel gases. As a result of approximate 1,000 hours operation of the cell, increasing the time of the pressurized operation at a pressure of 5 ata and above increase the degree of methanation and decrease significantly the cell potential. Judging from this pressurized test, a pressure of about 7 ata is suitable for the high level operation of the cell, and it is difficult to improve the cell potential for the pressurized operation at a pressure more than 7 ata. It is necessary to make sure of the optimum operated pressure considering the methanation in the system design, for the sake of the fact which methanation has complex mechanism related with humidification and gas diffusion. (25 figs, 11 tabs, 11 refs)

22337 (LBL—26054) Electrocatalysts for oxygen electrodes: Final report. Yeager, E. (Lawrence Berkeley Lab., CA (USA)). Sep 1988. Contract AC03-76SF00098. 103p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008852/JAW.

The performance of low and moderate temperature fuel cells and rechargeable metal-air batteries is limited by the catalytic activity and life of the O_2 electrocatalysts. The overall objective of this research has been the development of much more effective electrocatalysts for O_2 reduction and generation,combining high catalytic activity with long-term stability in concentrated acid and alkaline electrolytes. Research emphasis continues to be on achieving a fundamental understanding of the mechanisms for O_2 reduction and generation, including the factors controlling activity and stability. 32 refs., 56 figs., 2 tabs.

22338 (NEDO-P—8709) Investigation and research on a hydrogen feed system of the phosphoric acid fuel cell power plant. (New Energy and Industrial Technology Development Organization, Tokyo (Japan)). Mar 1988. 112p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88756846/JAW.

Investigation and research were made on the two items which can be considered as the factors to promote the introduction of the fuel cell, that is to say, the development of a steam reformer based on a thermal effective conversion technology (hereafter shall be called 'TECT'), and the utilization of by-product hydrogen from chemical industries as feedstock for a fuel cell power plant. In studying the application of TECT to the steam reformer for a fuel cell power plant, a basic analysis and experimental research into the heat transfer and reaction were carried out, as well as a research using axial cylindrical prototype apparatus. Though the axial symmetric cylindrical type TECT reformer has limit in capacity as single unit (i.e., the range from 200kW to 500kW for the phosphoric acid fuel cell power plant), the size within the scale range of the required steam reformer is minimized extreamly. In addition to the compactness, its high efficiency of load following is most appropriate in use for the small and intermediate sized on-site fuel cell power plant. As a result of case study for the fuel cell power plant using the by-product hydrogen, in future, a possibility to introduce this system into a petrochemical complex commercially was considered. (38 figs, 10 tabs, 4 refs)

22339 (NEDOJ-P—8741) Feasibility survey concerning demonstration of fuel cell systems in Thailand. Iijima, Takamichi. (New Energy and Industrial Technology Development Organization, Tokyo (Japan)). Dec 1987. 137p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756491/JAW.

Concerning the demonstrative introduction of a phosphoric acid fuel cell system into Thailand, a study was made on the effectiveness of the development from the demonstration stage to the stage of the wide spread of its usage and the approach for conducting the demonstrative research suitable for the technological level of Thailand, after grasping the actual situation by the field survey. In Thailand, the positive utilization of domestic energy such as natural gas has aggressively been pursued and the growth of electric power demand and supply is 9% per annum among which the regionwise breakdown shows considerable growth in the local regions and the sectorwise breakdown shows considerable growth in the household and agricultural sectors. The power generated is expected an increase of 6% or more in the future and the potentiality of positive utilization of natural gas as well as exhaust heat and the introduction of the fuel cell system due to its possibility for independent local usage are high. Incidentally, upon introduction, it is a promising utilization style to install a fuel cell in replacing the obsolete thermal power and it is required to develop technology concerning the conversion of cell fuel from LNG to natural gas, the pretreatment of flowing natural gas, and the utilization of the exhaust heat from a fuel cell for drying and low temperature storage of agricultural products, etc.. (29 figs, 45 tabs)

22340 Dendrite inhibitor. Miller, W.E. (to Dept. of Energy). US Patent Application 7-203,362. 7 Jun 1988. 10p. Contract W-31109-ENG-38. DE89009656 NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009656/JAW.

An apparatus for removing dendrites or other crystalline matter from the surface of a liquid in a matter transport process, and an electrolytic cell including such an apparatus. A notch may be provided to allow continuous exposure of the liquid surface, and a bore may be further provided to permit access to the liquid. 2 figs.

22341 Fabrication of solid oxide fuel cell by electrochemical vapor deposition. Riley, B.; Szreders, B.E. (to Dept. of Energy). US Patent Application 7-184,476. 26 Apr 1988. 20p. Contract W-31109-ENG-38. DE89009605 NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009605/JAW.

In a high temperature solid oxide fuel cell (SOFC), the deposition of an impervious high density thin layer of electrically conductive interconnector material, such as magnesium doped lanthanum chromite, and of an electrolyte material, such as yttria stabilized zirconia, onto a porous support/air electrode substrate surface is carried out at high temperatures ({approximately}1100{degree}{minus} 1300{degree}C) by a process of electrochemical vapor deposition. In this process, the mixed chlorides of the specific metals involved react in the gaseous state with water vapor resulting in the deposit of an impervious thin oxide layer on the support tube/air electrode substrate of between 20--50 microns in thickness. An internal heater, such as a heat pipe, is placed within the support tube/air electrode substrate and induces a uniform temperature profile therein so as to afford precise and uniform oxide deposition kinetics in an arrangement which is particularly adapted for large scale, commercial fabrication of SOFCs.

22342 **Solid oxide fuel cell matrix and modules.** Riley, B. (to Dept. of Energy). US Patent Application 7-184,918. 22 Apr 1988. 33p. Contract W-31109-ENG-38. DE89009607 NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009607/JAW.

Porous refractory ceramic blocks arranged in an abutting, stacked configuration and forming a three dimensional array provide a support structure and coupling means for a plurality of solid oxide fuel cells (SOFCs). The stack of ceramic blocks is self-supporting, with a plurality of such stacked arrays forming a matrix enclosed in an insulating refractory brick structure having an outer steel layer. The necessary connections for air, fuel, burnt gas, and anode and cathode connections are provided through the brick and steel outer shell. The ceramic blocks are so designed with respect to the strings of modules that by simple and logical design the strings could be replaced by hot reloading if one should fail. The hot reloading concept has not been included in any previous designs. 11 figs.

22343 **Integration of a fuel cell/battery power source in a small transit bus system.** Patil, P.G.; Christianson, C.C.; Romano, S. (US Dept. of Energy (US); Argonne National Lab (US); Georgetown Univ. (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889120.

Transportation is the largest single energy user in the United States and accounts for approximately 64% of our current petroleum consumption. Fuel cells using non petroleum fuel such as methanol can potentially provide the advantages of an ICE in a power system, but with clean and quiet operation. Because a fuel cell will deliver power as long as fuel and air are supplied, the range is limited only by the amount of fuel carried and can directly replace the ICE. The objective of this program is to advance the fuel cell/battery and control technologies in an integrated fashion using available powertrains in a test-bed bus for urban applications. Recently, The Department of Energy awarded two contracts to conduct trade-off analysis, define performance specifications and perform laboratory evaluations of a fuel cell/battery power source, including a motor and a controller on a dynamometer. This paper discusses the program's approach and some results of these analyses.

22344 **International fuel cell technology activities.** Hagey, G.L.; Hirschenhofer, J.H. (Office of Fossil Energy, DOE, Germantown, MD (US); Gilbert/Commonwealth, Inc., Reading, PA (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889041.

Power plants based on fuel cell technology exhibit characteristics such as modularity, minimum performance penalties for small sizes, low emissions, multi-fuel capability, independent operation, cogeneration capability, high efficiency, and minimum or no water requirements. These characteristics enhance the application of fuel cell technology for a wide variety of power needs. In addition to basic electric power production, fuel cell power plants have been or are being considered for: - Cogeneration - Applications requiring unattended operation - Remote power for rural areas and islands - Power produced from waste and biomass fuels - Power for land, sea, and space vehicles - Military applications. This application variety has promoted interests in different parts of the world based on diverse needs. In turn, the wide range of application interests has spawned international technology development, albeit on a more limited scale. The purpose of this paper is to identify the breadth of international fuel cell interests outside the U.S. This paper lists representative fuel cell achievements in the U.S.

22345 **Recent advances in monolithic solid oxide fuel cell development.** McPheeters, C.C.; Balachandran, U.; Blackburn, P.E.; Busch, D.E.; Dees, D.W.; Dorris, S.E.; Dusek, J.; Heiberger, J.J.; Leu, H.; Majumdar, S. (Argonne National Lab., Argonne, IL (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889207.

The Argonne Monolithic Solid Oxide Fuel Cell (MSOFC) is fabricated in a honey comb structure having alternate corrugated and flat layers similar to corrugated paperboard. This honeycomb structure, shown schematically in this paper is lightweight yet strong. The materials used to fabricate the MSOFC include yttria-stabilized zirconia as the electrolyte, alkaline earth-doped lanthanum chromite as the interconnection material (bipolar plate), strontium-doped lanthanum manganite as the cathode or air electrode, and yttria-stabilized zirconia-nickel cermet as the anode of fuel electrode. The high power densities of the MSOFC allow it to be used in many applications that would not be possible for other fuel cell designs. Some of these applications include lightweight, mobile power supplies as well as power sources for helicopters and aircraft, automobiles, space platforms, etc. The MSOFC is particularly suited for mobile power applications because of its ability to reform hydrocarbon fuels within the fuel channels.

22346 **Effects of operating parameters on PAFC stack performance.** Le, M.T.; Holman, R.R.; Liao, W.L. (Westinghouse Electric Corp., Advanced Energy Systems Div., PO Box 10864, Pittsburgh, PA (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889202.

This work was performed to assess actual relationships of phosphoric acid fuel cell voltage responses obtained from subscale cells with air-cooled and full size cells in stacks as a function of operating parameters. Key relationships were verified and found to be in agreement with the Nerst equation. A baseline technology stack (Stack W010-21) was chosen to perform the designed mapping test. Stack parameter characteristics and interactions of operating parameters on fuel cell performance were obtained in pressurized operation. Controlled variances were introduced for current, temperature, reactant (anode fuel and air) utilizations, coolant temperature drop and different anode fuel constituents (100% H/sub 2/ or 75% H/sub 2/ and 25% CO/sub 2/ by mode fuel). The effects of variance of these operating parameters on cell performance were empirically correlated and found to be in excellent agreement with theoretical values. Predicted interactions where determinable were also verified. An emperical equation was developed to predict cell voltages as a function of the measurable parameters.

22347 **Oxygen separation from air using zirconia solid electrolyte membranes.** Suitor, J.W.; Marner, W.J.; Schroeder, J.E.; Losey, R.W.; Ferrall, J.F.; Rohatgi, N.K. (Jet Propulsion Lab., California Institute of Technology, Pasadena, CA (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889206.

The development of alternate sources of oxygen other than from air liquefaction has been identified as a significant research need for the continued development of coal gasification. Air separation using a zirconia solid electrolyte membrane is one possible alternate source of oxygen. The objective of this multiyear effort is the development, fabrication, and testing of a zirconia oxygen production module capable of delivering approximately 100 liters/min of oxygen. The operation of the zirconia oxygen separator is similar to the high temperature solid electrolyte fuel cells. The different requirements for the two systems are substantial, requiring developmental work on the oxygen separator. The oxygen separation capability of the zirconia membrane is derived from its ability to function as an electrodialysis membrane and selectively remove oxygen from gas mixtures containing oxygen. The effort thus far has consisted of a systems analysis, economic assessment, basic research including materials development and small cell testing, and improvement of the manufacture of cell components. The ultimate project goal is the operation of a 100 liter/min oxygen production unit.

22348 **Fuel cells as energy storage devices for multimegawatt space power systems.** Hagey, G. (U.S. Dept. of Energy, Washington, DC (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

Fuel cell power systems are a candidate technology for energy storage and multimegawatt burst power (up to 1,000 MW for up to 2,000 seconds) for Strategic Defense Initiative (SDI) applications. SDI fuel cell systems must have both high specific power and high specific energy. Preliminary SDI energy storage system performance goals target a specific power of 3.2 kW/kg and a specific energy of 444 W-hr/kg. Specific power is the most important parameter and determines the high electrochemical performance required by candidate fuel cells. Of the fuel cell technologies under development, advanced alkaline and solid oxide fuel cells (SOFC) appear capable of achieving the SDI energy storage system performance goals.

22349 **Kinetics of the ferrous/ferric electrode reaction at high temperatures and pressures.** Nagy, Z.; Yonco, R.M.; Hung, N.C. (Argonne National Lab., Div. of Materials Science and Chemical Technology, Argonne, IL (US)). pp 406-407 of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. Pennington, NJ; The Electrochemical Society (1987). (CONF-871027—).

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

There is mounting experimental evidence which indicates that the Tafel slope of some electrode reactions does not follow the classically expected temperature dependence. The relation $b = 2.3 RT^{*}\alpha F$ is not confirmed in some cases with a constant α; an α changing linearly with the absolute temperature, and even more complex relations have been suggested to explain the experimental results. Several theoretical explanations have been put forth and examined, but no current theory can explain all the experimental data. The anomalous temperature dependence of the Tafel slope has been mostly observed with multi-step reactions, such as the hydrogen evolution reaction and oxygen reduction. The authors have developed experimental capability for electrode kinetic studies in aqueous solutions at high temperatures and high pressures (HTHP) extending to at least 300°C and 10 MPa. In addition to the obvious requirements of withstanding corrosive environments at HTHP, the cell also has to fulfill special design requirements dictated by the transient measuring techniques to be used to study the reactions whose rate is expected to be fast under HTHP conditions. The authors are using fast pulse relaxation techniques with numerical data analysis. Recent improvements in these techniques have extended their usefulness to orders of magnitude faster reactions that was hitherto measurable with the classical relaxation techniques.

3008 Miscellaneous Converters

22350 **(NEDOJ-P—8720) Investigation of utilization feasibility of methanol for industrial engines (part 2).** Otsuka, Masuhiko; Takakura, Tsuyoshi; Okamura, Joichi; Deguchi, Kyoji; Ikematsu, Masaki; Hasuike, Hiroshi; Kurosawa, Atsushi; Maruyama, Naoko. (New Energy and Industrial Technology Development Organization, Tokyo (Japan)). Mar 1988. 128p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88756485/JAW.

Basing upon the result of the investigation in FY 1986, technical and economical feasibilities, etc. were studied in the investigation in FY 1987 with regard to the utilization of methanol for stationary engines laying stress on engines for power generation (including congeneration) which occupied especially an important position among industrial engines. Stationary diesels for the 400-2,000kW class power generation or cogeneration requires high reliability which is able to make the operation without overhaul for one year or more as engines for power generation. In order to fulfil the above requirement, the technical feasibility studies on the way of forming an ignition point including flame propagation, etc. were conducted. Besides, having studied the economical feasibility, the following conclusions were obtained inter alia that; (1) Under the constant NOx control, methanol engines were fairly advantageous in terms of the initial cost such as the installation cost and the running cost concerning denitration. (2) Because of the above, methanol was acceptable even its cost was fairly high from the viewpoint of the cost per calorific value. (54 figs, 46 tabs)

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 22409

3201 Buildings

REFER ALSO TO CITATION(S) 21669, 21911, 21911, 21971, 22285, 22286, 22287, 22288, 22289, 22290, 22311, 22421, 23889

22351 **(AFME—83.1859) Technical and economical study of a (water/ice) latent heat storage system as a cold source for heat pumps.** Brejon, P.; Marchio, D. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). May 1985. 81p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757217/JAW.

The Glasoltherm heat production system was developed and connected to an electric energy production concept (thermo-electric micro-power station). A sensibiliy study is conducted in order to evaluate the effects of dimension parameters on the various components (exchanger area, storage volume, etc...). Six application projects are evaluated from the technical and economical points of view. It appears that the ice storage concept is efficient but uneconomic for a single house. Meanwhile, the thermo-electric micro-station is economically interesting for old and new dwelling buildings.

22352 **(AFME—84.232E) Thermal comfort in hot climates.** Berges, X., Grivel, F.; Tubiana, M.J.; Tubiana, J. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris; Centre National de la Recherche Scientifique, 75 - Paris (France)). Sep 1985. 257p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88757225/JAW.

An on-site study of thermal comfort in modern or ancient, urban or rural dwellings in tropical countries (Ivory Coast) is presented. Through a panel enquiry in the various types of houses in Ivory Coast, the author analyzes the thethe thermal comfort of various parts of the population. Based on physical measures (tempera-

ture, humidity, ventilation) and discussions, the thermal constraints, the thermal behaviour and the ethno-sociological satisfaction are analyzed. Building designs and equipment recommendations are discussed.

22353 **(AFME—84.0976) Development of a computer software for building energy management.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 337p. (In French). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88757214/JAW.

A software for the energy evaluation and energy management of a building is presented. The software can handle the meteorological data, the shading influence, the building envelope characteristics, the heat exchanger and space heating equipment characteritics and performances, the characteristics of the glazing, walls and floors, occupancy, air conditioning requirements, air quality, etc. The program allows the comparison of various heating strategies and equipments and the operating optimization through control systems.

22354 **(AFME—85.12.1004) Energy conservation in overseas French departments, present evaluation and prospects.** Duport; Traisnel; Vergnet; Gaudemer; Melchior; Millet; Thonnon, M.; Meunier; Rio. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris; Centre Scientifique et Technique du Batiment, 75 - Paris (FR); Bureau Recherches Geologiques et Minieres (BRGM), 75 - Paris). (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). Jan 1985. 198p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88757216/JAW.

Various aspects concerning energy conservation in tropical French departments are presented: photovoltaic generator utilization and potentials, solar domestic water heating, hydroelectric small scale power plants, natural ventilation of the dwellings, evaluation of the energy demand reduction through optimization of the water heating devices, air conditioners, freezers, etc., architectural design and construction materials for energy conservation in buildings, biomass energy up-grading, evaluation of the thermal comfort requirements.

22355 **(AL/GSS—1988) Wood and coal burning appliances.** (Alberta Labour, Edmonton (Canada). General Safety Div.). [1988]. 27p. (MICROLOG—88-05121). Alberta Labour, 10808-99 Ave., Edmonton, AB, Canada T5K 0G3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A manual is provided to provide guidelines on selecting and using solid fuel-fired appliances of the kinds used in Alberta: stoves (for cooking and space heating), space heaters, and ranges (normally used only for cooking). Safety aspects of installing and operating these appliances are emphasized, notably in regard to preventing fires. Floor and wall protection, chimney systems and stovepipes, and proper drafting are all covered in separate chapters. Includes glossary. 20 figs., 3 tabs.

22356 **(CONF-890273—1) The thermal resistance of flat powder-filled evacuated panels.** Graves, R.S.; Yarbrough, D.W.; McElroy, D.L. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 35p. NTIS, PC A03 - OSTI. Order Number DE89008243/JAW.

From 5. international conference on thermal insulation; San Francisco, CA, USA (27 Feb 1989).

The need to develop high thermal resistance insulations that do not use chlorofluorocarbons has resulted in renewed interest in evacuated powder-filled panel insulations. Evacuated panels containing small diameter milled perlite or silica particles have been studied using a linear heat flow measurement technique. Thermal resistivities (R-value for one-inch of thickness) as high as 19.3 ft^2{center←dot}h{center←dot}{degree}F/Btu-in. have been observed for silica panels. Thermal measurements completed for a commercially produced evacuated panel containing perlite have shown thermal resistivities from 9.0 to 18.1 ft^2{center←dot}h{center←dot}{degree}F/Btu-in. Thermal resistance measurements have been repeated to determine changes in thermal performance with time (aging). 8 refs., 7 figs., 3 tabs.

22357 **(CONF-890351—7) Activities in support of the wax-impregnated wallboard concept.** Kedl, R.J.; Stovall, T.K. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 14p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008566/JAW.

From Thermal energy storage program review; New Orleans, LA, USA (15 Mar 1989).

The concept of octadecane wax impregnated wallboard for the passive solar application is a major thrust of the Oak Ridge National Laboratory (ORNL) Thermal Energy Storage (TES) program. Thus, ORNL has initiated a number of internal efforts in support of this concept. The results of these efforts are: The immersion process for filling wallboard with wax has been successfully sealed up from small samples to full-size sheets; analysis shows that the immersion process has the potential for achieving higher storage capacity than adding wax filled pellets to wallboard during its manufacture; analysis indicates that 75{degree}F is close to an optimum phase change temperature for the non-passive solar application; and the thermal conductivity of wallboard without wax has been measured and will be measured for wax impregnated wallboard. In addition, efforts are underway to confirm an analytical model that handles phase change wallboard for the passive solar application. 4 refs., 10 figs.

22358 **(CONF-890430—2) Cogeneration by retrofit of steam turbines to existing coal-fired heating plants.** Holcomb, R.S. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009622/JAW.

From American Institute of Chemical Engineers spring national meeting; Houston, TX, USA (2 Apr 1989).

One potential opportunity for cogeneration is the retrofit of steam turbine-generators in existing medium-pressure heating plants, where presently the steam is needed only at low pressure for heating or process use. This paper presents the results of the analysis of one case in a study of the economic potential of retrofitting turbine-generators to existing medium-pressure coal-fired heating plants. A cogeneration cycle was devised to optimize the utilization of the turbine capacity while supplying steam to a variable heating load. The effects of steam pressure and electric power rates on the economics as variable parameters were studied. The economics of the turbine retrofit and the option of installing a new high-pressure boiler and turbine-generator were compared. 6 figs., 4 tabs.

22359 **(CRIE-W—87020) Development of advanced heat pump (2). Prelimirary test of two-stage compression heat pump.** Iwatsubo, Tetsushiro; Saikawa, Michinori; Hamamatsu, Teruhide. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Mar 1988. 33p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756838/JAW.

A heat pump driven by electricity is one of the excellent electricity utilization systems and is promoted to be widely used. An advanced heat pump has been investigated to enlarge its applications in the field of hot water supply for domestic use which will be competitive with city gas and air conditioning in large scale buildings. An experimental unit with two-stage compression system was designed, which has the multi-function of air conditioning and hot water supply, and the trial system was fabricated. In the design, followings were considered; cooperative operations of two compressors by inverter driving, the temperature conditions of both the air for the air conditioning and the heat source, additional setting of the intermediate heat exchanger. The test operation was carried out with checking the start up procedure, the control sequence and so on. The probability of five operation modes: cooling, heating, hot water supply, cooling/hot water supply, and heating/hot water supply, were confirmed. In the mode of heating/hot water supply the hot water temperature was increased to 65°C, the excellent performance in hot water supply was demonstrated. (21 figs, 8 tabs, 1 photo, 5 refs)

22360 **(CRIE-W—87029) Development of advanced heat pumps (Part 3). Fundamental approach on two-stage compression system.** Saikawa, Michinori; Iwatsubo, Tetsushiro; Hamamatsu, Teruhide. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Mar 1988. 22p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756842/JAW.

A heat pump using electricity has benefits in many aspects such as energy conservation, pollution abatement and so on. As one of the measures for developing power demand, the electric power industry is engaged in its usuage and improving the performance. In addition to usual air conditioning, the performance of the system while hot water supply mode was mainly studied aiming at drastic improvement. By adopting the two-stage compression method, the irreversible losses in the heat exchanges were reduced. Though the Coefficient of Performance of the conventional system adopting the single-stage method is shown the value of 1.67, it is shown the values of 2.16 to 2.8- in the two-stage method, the performance was increased by about 70%. The results of experiments using a miniature experimental device showed good agreement with the predicted performance. In the annual hot water supply load of 4,240mcal, the annual running cost of this system is evaluated as 38,800 yen, this figure is lower than that of city gas of 47,100 yen. When only night time electricity is useed, the cost is reduced to 10,700 yen whichis less than that of kerosene. (11 figs, 5 tabs)

22361 **(DOE/CE/30752—T2) Evaluation procedure for building energy performance prediction tools.** (Building Energy Design Tool Development Council #914, Washington, DC (USA)). Aug 1985. Contract AC03-83CE30752. 42p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004162/JAW.

The ASEAM program has been developed for the Building Systems Division of the US Department of Energy (DOE) as a public domain energy analysis tool for commercial buildings. This microcomputer program is based upon simplified analysis methods using modified annual "bin temperature frequency data." The load calculation routines are based on a methodology documented by the ASHRAE Technical Committee on Energy Calculations (TC 4.7). The HVAC system and heating and cooling plant routines were developed by W.S. Fleming and Associates (WSFA). ASEAM is an "interactive" computer program. Its algorithms include heating and cooling calculations, and HVAC system and plant calculation routines with options to size cooling equipment and air flows. The program is structured so that input and output files can be manipulated to perform comparison studies. In addition to load calculation and HVAC system energy consumption reports, annual estimates for seven (7) energy end use categories are reported: Heating, cooling, HVAC pumps, HVAC fans, cooling tower, lighting, and equipment.

22362 **(DOE/CE/63524—T1) Tallahassee partnerships in low-income residential retrofits: Final report, 1987--1988.** (Tallahassee Housing Foundation, FL (USA)). 1988. Contract FG01-86CE63524. 67p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009121/JAW.

Sixty-two homes were weatherized by the Tallahassee Housing Foundation and 59 by Greater Miami Neighborhoods, Inc. The final reports for the two areas are attached. Tallahassee Housing Foundation also produced a "How To" manual which has been distributed to groups interested in similar activities. The manual is included.

22363 **(DOE/CE/64615—T4) Managing energy efficient buildings.** (New Mexico Energy and Minerals Dept., Santa Fe, NM (USA). Resource Development and Management Div.). Aug 1986. Contract FG01-86CE64615. 37p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009244/JAW.

This paper is a troubleshooting guide for energy efficient systems in buildings. Topics covered range from lighting systems to boiler systems. (JF)

22364 **(EPRI-CU—6255) Radiant barrier applications: Symposium and workshop proceedings.** Isaksen, L. (Electric Power Research Inst., Palo Alto, CA (USA); Analysis and Control of Energy Systems, Inc., Los Altos, CA (USA)). Feb 1989. 52p. (CONF-8804127—Summ.). Research Reports Center, Box 50490, Palo Alto, CA 94303.

From EPRI radiant barrier applications symposium and workshop; Chattanooga, TN, USA (15 Apr 1988).

Electric utilities and their customers are continually looking for ways to improve the thermal integrity of buildings. Radiant barrier systems can reduce summer air conditioning loads by reducing radiant heat transfer in attics. EPRI conducted two programs to help utilities with radiant barriers. A Symposium and Workshop were conducted in April 1988. The Symposium reviewed the state of the art in radiant barriers. The Workshop brought industry experts together to identify research needs for radiant barriers. The Workshop found that research is needed in six major areas. Listed in order of importance these are: (1) Field and laboratory testing, (2) Materials research, (3) Modeling, (4) Materials standards, (5) Economic issues, and (6) Installation methods. The leading research topics within these six major areas in order of importance include:(1) Modeling to fill voids in existing field data and aid in the development of performance standards, (2) Calculation of energy savings for various configurations, (3) Analysis of existing data to better understand radiant barrier performance, (4) Assessment of the effect of dust accumulation on performance, (5) Development of standard testing procedures, (6) Development of systems standards, (7) Measurement of changes in the emissivity of radiant barrier materials with time, (8) Determination of the possibility of moisture accumulation under horizontal radiant barriers during heating season operation, (9) Ventilation effects, (10) Configuration testing, (11) Costs of new and retrofit applications, and (12) Characterization of side effects. 34 refs., 5 figs.

22365 **(EPRI-CU—6268) Supermarket refrigeration modeling and field demonstration: Interim report.** Walker, D.H.; Deming, G.I. (Electric Power Research Inst., Palo Alto, CA (USA); Foster-Miller, Inc., Waltham, MA (USA)). Mar 1989. 295p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Electric Power Research Institute (EPRI) has undertaken a project to investigate supermarket refrigeration. The objectives of this project are (1) to develop an energy use and demand model of supermarket refrigeration systems and (2) to carry out an extensive field test of such systems in an operating supermarket. To accomplish these goals, a supermarket owned by Safeway Stores, Inc., and located in Menlo Park, CA, with an existing conventional refrigeration system utilizing single compressor units, was equipped with a state-of-the-art system with multiplexed parallel compressors. The store and both refrigeration systems were thoroughly instrumented and a test schedule was prepared and executed. Presented in this report are the preliminary results of this field test along with the initial validation of the energy use and demand model. 62 figs., 47 tabs.

22366 **(K/CSD/INF—88/14) Analysis of seven thermal bridges identified in a commercial building.** Childs, K.W. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1988. Contract AC05-84OT21400. 25p. (CONF-880627—7). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008466/JAW.

From ASHRAE annual meeting; Ottawa, Canada (25 Jun 1988).

Seven thermal bridges occurring in a large modern office building are identified. The impact that these bridges have on building envelope heat flow and minimum interior surface temperature is investigated using a finite-difference heat transfer computer program. Assumptions that are made in the development of two- and three-dimensional numerical models are discussed. Steady-state numerical models are employed to determine parameters that can be used to calculate corrections to the values for heat flow and interior surface temperature obtained from one-dimensional analyses. The need for a means of characterizing the dynamic thermal response of bridges is also discussed, and two different numerical approaches to the calculation of response factors (or conduction transfer functions) are explored. 5 refs., 9 figs., 5 tabs.

22367 **(LBL—21578-Rev.) Residential heating and cooling energy cost implications associated with window type: Revision.** Sullivan, R.; Selkowitz, S. (Lawrence Berkeley Lab., CA (USA)). Nov 1986. Contract AC03-76SF00098. 21p. (CONF-870101—8-Rev.). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008149/JAW.

From American Society of Heating, Refrigerating, and Air-Conditioning Engineers meeting; New York, NY, USA (18 Jan 1987).

We present a comparative study in which residential heating and cooling energy costs are analyzed as a function of window glazing type, with a particular emphasis on the performance of windows having low-emittance coatings. The DOE-2.1B energy analysis simulation program was used to generate a data base of the heating and cooling energy requirements of a prototypical single-family ranch-style house. Algebraic expressions derived by multiple regression techniques permitted a direct comparison of those parameters that characterize window performance: orientation, size, conductance, and solar transmission properties. We use these equations to discuss the energy implications of conventional double- and triple-pane window designs and newer designs in which number and type of substrate, low-emittance coating type and location and gas fill are varied. Results are presented for the heating-dominated climate of Madison, WI, and cooling-dominated locations of Lake Charles, LA, and Phoenix, AZ. The analysis shows the potential for substantial savings but suggests that both heating and cooling energy should be examined when evaluating the performance of different fenestration systems. Coating and substrate properties and the location of the coating in the glazing system are shown to have moderate effects as a function of orientation and climate. In addition, with the low-conductance glazing units, the window frame becomes a contributor to overall residential energy efficiency. 4 refs., 10 figs., 1 tab.

22368 **(LBL—23153) Energy efficiency lighting on board naval ships: Phase 2 (The T-8 lamp system).** Verderber, R.R. (Lawrence Berkeley Lab., CA (USA)). 31 Jan 1987. Contract AC03-76SF00098. 21p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008834/JAW.

This report describes the development and performance of the T-8 fluorescent lamp-ballast system. Similar to the Phase I effort, the cooperation of the lamp and ballast companies (GTE, North American Philips Lighting, and IOTA Engineering) were required for the successful result. The above companies submitted prototype lamps and ballasts to the Lawrence Berkeley Laboratory Lighting Group to evaluate. The lamp designs were modified as required and the optimum system selected. Two-lamp designs and one ballast were chosen and tested to determine if they met the Navy specifications. The second section describes the lamp-ballast specifications. This section includes the measured thermal performance from an ambient of 10{degree}C to 60{degree}C. 1 ref., 8 figs., 11 tabs.

22369 **(LBL—23617) Daylighting design for the Pacific Museum of Flight: Energy impacts.** Bazjanac, V.; Winkelmann, F. (Lawrence Berkeley Lab., CA (USA)). Sep 1988. Contract AC03-76SF00098. 19p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008835/JAW.

The daylighting performance of the Pacific Museum of Flight in Seattle, WA, has been analyzed using the DOE-2.1C building energy simulation program. The main exhibit areas of this museum are enclosed on three sides by glass walls and the 48,000-ft^2 roof is completely glazed. Because of the large glass areas, a detailed thermal simulation of the building was carried out during its design phase in order to select glazing parameters that would avoid excessive summer solar heat gain, reduce winter heat loss and, at the same time, provide enough natural light to significantly reduce electric lighting loads. Glazing choices considered included conventional glass, heat mirror, and glass with a low-emissivity coating. On/off, stepped and continuous dimming lighting control systems were analyzed. Daylighting was found to be very effective in reducing annual electric lighting load, peak electrical demand, and the overall annual energy consumption. 14 refs., 10 figs., 4 tabs.

22370 **(LBL—24215) Applied Science Division annual report, FY 1987: Windows and lighting program.** (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 36p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008837/JAW.

Over 30% of all energy used in buildings is attributable to two building elements, windows and lighting. Together they account for annual consumer expenditures of over $50 billion. Each affects not only energy use by other major building systems but also comfort and productivity, factors that have a far greater influence on building economics than direct energy consumption alone. Windows play a unique role in the building envelope, physically separating the conditioned space from the world outside without sacrificing vital visual contact. Lighting systems make it possible to conduct any task of any visual difficulty anywhere in the indoor environment, and at the same time define the luminous qualities of the indoor environment. The two building elements are thus essential components to any comprehensive building science program. The Windows and Daylighting Group focuses on developing the technical basis for understanding the energy-related performance of windows. If the flow of heat and light through windows and skylights can be properly filtered and controlled, these building elements can outperform any insulated wall or roof component and provide net energy benefits to the building. The group's investigations are designed to develop the capability to accurately predict net fenestration performance in residential and commercial buildings. 38 refs., 25 figs.

22371 **(LBL—25526) Planning for an energy-efficient future: The experience with implementing energy conservation programs for new residential and commercial buildings: Volume 2, Program descriptions.** Vine, E.; Harris, J. (Lawrence Berkeley Lab., CA (USA)). Sep 1988. Contract AC03-76SF00098. 201p. NTIS, PC A10/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008858/JAW.

This volume contains the descriptions of programs contained in Volume 1 of our main report: Planning for an Energy-Efficient Future: The Experience With Implementing Energy Conservation Programs For New Residential and Commercial Buildings (LBL-25525).

22372 **(NP—9770290) Retrofitting measures for buildings in order to save energy - how to do them properly. 2. ed.** Stumm, F.; Koenig, N.; Kelzenberg-Wendig, I. (Landesgewerbeamt Baden-Wuerttemberg, Stuttgart (Germany, F.R.). Zentrale Informationsstelle fuer Energiefragen (ZIE)). Jul 1987. 22p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770290/JAW.

The Fraunhofer-Institute for Physics of Buildings conducted a study about modernisation of buildings. The study is addressed mainly to craftsmen's enterprises and the building trade are usually the ones to carry out such measures. One aims at informing them about energy-saving construction measures and their impact on the building and its inhabitants. Recurring damages their causes and ways to avoid them are a special point of interest covered as well. A list of books on the subject is supplied at the end. (BWI).

22373 **(NP—9770306) Wall panel heating in residential buildings.** Straehle, E. (Technische Univ. Braunschweig (Germany, F.R.). Fachbereich fuer Architektur). 1 Dec 1986. 251p. (In German). NTIS (US Sales Only), PC A12. Order Number DE89770306/JAW.

This thesis studies possibilities and limits of wall panel heating in residential buildings with special consideration of the effects on the room climate, the thermal situation and the physics of the building. A brief survey of the development is followed by an explanation of the basics, the influence of wall panel heating on the room climate and the thermal behaviour of wall plate heatings (analysis of wall panel heatings, plate heaters, meandering and register-shaped piping, convectors, in- and outflow of air). The influence of wall panel heating on the physical behaviour of the room's surrounding surfaces and the building costs are studied. Practical aspects of installing wall panel heating are described. (HWJ).

22374 **(NP—9770317) Studies on moduls with transparent heat insulation at the test facade of the ISE (Institute for Solar Energy Systems).** Bollin, E.; Platzer, W.; Stahl, W.; Wittwer, V. (Fraunhofer-Institut fuer Solare Energiesysteme (ISE), Freiburg im Breisgau (Germany, F.R.)). [1987]. 27p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770317/JAW.

Experiences with the test wall of the ISE show that the construction of the frame elements meet the requirements of an outer facade. The control with blinds and hydraulic air elements worked reliably and efficiently. During the summer there was an additional cooling effect. When applying the LEGIS-priciple in practice one should try to keep fringe losses at frames or exposed parts of the wall small. A closed coverage of one area should be preferred to insulated individual elements. This can, however, be done in modular fashion with linkable individual components.

22375 **(NP—9770320) Heating system for a new detached one-family house.** (IEA Heat Pump Center, Eggenstein-Leopoldshafen (Germany, F.R.)). 1986. 4p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE89770320/JAW.

This brochure describes the heating system of a one-family house consisting of a monovalently operated salt water/water heat pump with ground absorbers to utilize the solar energy stored in the ground. The heated residential area is 200 m/sup 2/; in total, 2,000 m of absorbing pipes were laid in a depth of 1,8 m and with intervals of 40-50 cm. The specific heating costs were around DM 9.63/m/sup 2/ in 1984 and DM 11.20/m/sup 2/ in 1985. (BWI).

22376 **(NP—9770322) Heating system for a detached one-family house.** (IEA Heat Pump Center, Eggenstein-Leopoldshafen (Germany, F.R.)). 1985. 4p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE89770322/JAW.

The brochure describes a heating system consisting of a monovalent saltwater/water heat pump with a ground surface absorber, for utilization of the solar energy stored in the ground. The absorber pipes were laid in 16 separate parts of 100 m each; the living rooms are heated by means of a floor heating system. The specific heating costs in 1984 were 10.00 DM/m/sup 2/. The additional expenses of 10,000 DM in comparison to a conventional fuel oil heating system will be paid off within 4-5 years. (BWI).

22377 **(NP—9770323) Completion of an existing heating system in a detached two-family house.** (IEA Heat Pump Center, Eggenstein-Leopoldshafen (Germany, F.R.)). 1986. 4p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE89770323/JAW.

This brochure describes the retrofitting of an existing heating system in a two-family house with a saltwater/water heat pump (bivalent operation) and an energy fence. The heated residential area was 150 m/sup 2/; an energy fence of 108 plastic pipes of 5 m each was laid parallely and one above another. The efficient surface is 37 m/sup 2/. The energy fence helped to reduce the fuel consumption from 5,500 l to 1,400 l per year. The specific heating expenses were ca. 12.29 DM/m/sup 2/. The system shows that retrofitting with heat pump systems is profitable also for houses with poor isolation. (BWI).

22378 **(NP—9770326) Agriculture in Hessen. Hessian Land programme for promoting the development of renewable energy sources and their use in agriculture.** (Hessischer Minister fuer Landesentwicklung, Umwelt, Landwirtschaft und Forsten, Wiesbaden (Germany, F.R.)). [1984]. 173p. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770326/JAW.

The book presents the results of the Hessian pilot projects on the use of renewable energy sources in agriculture, e.g. straw-fueled and wood-chip-fueled heating systems, heat pumps, biogas plants, wind energy, and solar collectors.

22379 (NP—9770326, pp 17-24) **Heat recovery.** [1984]. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770326/JAW.

In Agriculture in Hessen. Hessian Land programme for promoting the development of renewable energy sources and their use in agriculture.

A lot of low level waste heat from animal shelters (10-20/ sup 0/C) is normally exhausted to the atmosphere. One type of heat recovery equipment for upgrading this waste heat is the electrically driven heat pump. This paper gives a short description of the function, design, and operation of this heat pump type. Some problems regarding the installation of unitary and split-type heat pumps (air-to-water and brine-to-water) in animal shelters are mentioned. The heat potential available from animals as a basis for the dimensioning of space heating systems is given in a diagram. (ALE).

22380 (NP—9770326, pp 25-35) **Pilot project: Heat extraction from ambient air.** Zwermann, K.; Zwermann, E. [1984]. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770326/JAW.

In Agriculture in Hessen. Hessian Land programme for promoting the development of renewable energy sources and their use in agriculture.

In 1980 new greenhouses (ground space 2 400 m/sup 2/) equipped with energy saving features were built in Usingen-Wernborn, Federal Republic of Germany. As a demonstration plant a solar-assisted heat pump (type Lahmeyer WW 150) using ambient air as the heat source was also installed. This brine-to-water heat pump is connected to a plate heat exchanger ('Energiestapel' type Lahmeyer LEA 4/150) located outside the greenhouses. The overall capitalized cost of the heat pump installation (heating capacity 144 kW) including a storage tank (volume 200 m/sup 3/) is DM 186 873.-. The plate heat exchanger working without a fan worked satisfactorily over the first 2,5 years of operation. Nevertheless, the designed heating capacity of the heat pump was never reached. One reason could be that the design wind velocity of $\geqq$ 2.5 m/s was seldom reached. The measured heating capacity was around 100 kW with an average coefficient of performance of 2.66. An economic analysis showed that a comparable oil-fired heating system would work cheaper by about DM 0,02 per kWh. (ALE).

22381 (NP—9770326, pp 36-40) **Pilot project: Air source heat pump utilizing exhaust air from animal shelters.** Hasecke, F. [1984]. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770326/JAW.

In Agriculture in Hessen. Hessian Land programme for promoting the development of renewable energy sources and their use in agriculture.

An air-to-water heat pump utilizing waste heat from animal shelters was installed in fall 1981 in Lichtenfeld/Fuerstenberg, Federal Republic of Germany. This demonstration plant supplies house and shelters with space heat and hot water. The designed heating capacity of the heat pump manufactured by Olsberg (type 39/514) is 21,6 kW. The installation is equipped with a hot water storage tank (350 l) and two 800 l buffer storage tanks and works in a monovalent operation mode. By operating the heat pump the climate of the shelters was improved. No corrosion at the evaporator was noticed by visual inspection. The overall investment amounted to DM 35 774.-. Because of a failure of the heat meters the designed coefficient of performance of above 3.5 could not be determined exactly. Without financial support this heat pump installation would not have been competitive to a conventional oil heating system. (ALE).

22382 (NP—9770326, pp 41-49) **Pilot project: Air source heat pump utilizing exhaust air from a dairy barn.** Fiedler, G. [1984]. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770326/JAW.

In Agriculture in Hessen. Hessian Land programme for promoting the development of renewable energy sources and their use in agriculture.

An air-source heat pump is used to heat a 230 m/sup 2/ farm house that is equipped with a low-temperature hydronic floor heating system. The installation is located in the State of Hessen, FRG. It consists of two split type 3.7 kW electric heat pumps manufactured by Alfa-Laval. One of the units uses exhaust air from a barn housing dairy cows as its heat source. The direct expansion evaporator is located in the barn and is connected via refrigerant lines to the heat pump. Corrosion problems were experienced with this evaporator. The other heat pump was installed as a back up unit

and uses ground water as its heat source. The system uses an 800 liter water tank as a thermal store. The tank is heated to 50/sup 0/ C at night by the air source heat pump. During the day the heat pump is used to maintain a 35/sup 0/C water temperature for the hydronic heating system. Operation during the winter of 1982/83 resulted in a COP of 3.22 for the air source unit. An analysis shows that the system is not economic over its 10 year operating period. The elimination of the back up heat pump would make this type of system more economical.

22383 (NP—9770326, pp 50-56) **Pilot project: Heat recovery from barn exhaust air.** Ebel, W. [1984]. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770326/JAW.

In Agriculture in Hessen. Hessian Land programme for promoting the development of renewable energy sources and their use in agriculture.

A brine-to-water heat pump manufactured by Kaelte-Fedder is used to recover heat from barn exhaust air. The recovered heat is used to heat the barn. The design heating capacity of the heat pump is 29.1 kW and the electric power input is 8.1 kW. Heat is recovered from the exhaust air via a brine heat exchanger constructed of HDPE tubes. The brine used is a water glycol mixture which is cooled by the evaporator of the heat pump. The system also has a 2000 liter thermal store using water. Performance measurements revealed COPS which were much lower than expected (2.38 rather than 3.5). It is suspected that the installed absorber is too small. An economic analysis shows that the operating costs for this system are 1.86 times those of a conventional oil fired heating system.

22384 **(NP—9770327) Energy transport through transparent and non-transparent outer walls with different structures. Interim report.** Schulz, H. (Ingenieurbuero Dr.-Ing. K. Gehlisch, Muenchen (Germany, F.R.); Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl C fuer Thermodynamik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1986. 152p. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770327/JAW.

Within the research project 'Energy transport through transparent and non-transparent facades of different character' the energy transport through different types of facades is being measured. A test stand, set up according to the Hotbox-method allows to study six rooms with different facades. The air temperature in the rooms is kept constant by a control system. The energy needed for this is supplied by large-heat exchangers and free convection. All heat flows to and from the room are measured and all meteorological data are recorded. With the evaluation programs it is possible to plot the measured data against time, to do the daily sums and to compare them with one another. In this way it is also possible to classify the measured data according to the meteorological situation so that one can draw conclusions on the solar generation factor or on an overall k value.

22385 **(ORNL/CON—255) Moisture measurements in single-family houses with attics containing radiant barriers.** Levins, W.P.; Karnitz, M.A.; Hall, J.A. (Oak Ridge National Lab., TN (USA)). Feb 1989. Contract AC05-84OR21400. 115p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008972/JAW.

Tests were conducted by Oak Ridge National Laboratory researchers at three unoccupied research houses in Karns, Tennessee, to determine the effects of moisture condensation on the underside of perforated horizontal radiant barriers during the winter of 1987-88. An experimental plan called for the houses to be operated at high indoor relative humidities (45 and 55% at 70{degree}F), with data concerning the attic moisture conditions collected by both visual and instrument measurements. The testing showed that moisture went through a diurnal cycle at the Karns research houses. Moisture could condense on the bottom surface of a horizontal barrier in cold (below 35{degree}F) weather, but it could also dissipate to the attic air during a normal Tennessee winter afternoon, leaving the barrier dry. In long periods of subfreezing weather, all the condensation did not vaporize, as some remained on the surface through the day. However, the testing did show that the moisture cycle occurring on a perforated horizontal radiant barrier during a typical Tennessee winter did not appear to pose any structural, wet insulation, or strained ceiling problems to the Karns research houses, even though they were operated at higher than normal indoor relative humidities. Care should be taken in extrapolating the observations of this experimental work to areas with prolonged periods of subfreezing weather. The diurnal moisture cycle under a barrier may be different in colder climates. Further testing of horizontal barriers in colder climates is recommended. 21 refs., 45 figs., 11 tabs.

22386 **(ORNL/CON—273) Energy-use impact of chlorofluorocarbon alternatives.** Fischer, S.K.; Creswick, F.A. (Oak Ridge National Lab., TN (USA)). Feb 1989. Contract AC05-84OR21400. 122p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008930/JAW.

The fully halogenated chlorofluorocarbons (CFCs) have been identified as contributing to reductions in stratospheric ozone. The United States has ratified and signed the Montreal Protocol mandating a phased reduction in the production of certain compounds containing chlorine and bromine, including CFC-11 and CFC-12, and the US Environmental Protection Agency is preparing rules to enforce the provisions of this international treaty. All of the major producers of these chemicals in the United States have announced that they will cease production of the fully halogenated CFCs as soon as alternative refrigerants and blowing agents are available. The CFCs that are affected by the Protocol, however, have high thermal efficiencies in refrigeration systems and foam insulations. There is a strong likelihood that national energy use will increase through the use of environmentally acceptable alternative chemicals and technologies. This study is to provide the US Department of Energy with an estimate of the potential severity of the energy-use impacts and an identification of the equipment and insulation applications that will be most seriously affected in terms of their energy use. It looks only at energy related applications of CFC-11 and CFC-12. It does not examine the energy impacts of alternative refrigerants for equipment that uses HCFC-22. 39 refs., 8 figs., 29 tabs.

22387 **(PNL-SA—16692) ATES/heat pump systems for commercial office buildings.** Brown, D.R.; Spanner, G.E. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1989. Contract AC06-76RL01830. 18p. (CONF-890351—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009163/JAW.

From Thermal energy storage program review; New Orleans, LA, USA (15 Mar 1989).

An aquifer thermal energy storage (ATES) system can be coupled with ground water heat pumps to recover thermal energy that is wasted in conventional ground water heat pump systems. The cost, performance, and overall system economics of three ground water heat pump systems (two conventional systems and one ATES-augmented system) were evaluated for two commercial office building sizes in two cities. Aquifer simulation predicted that relatively warm and cool wells were created by alternating the supply and rejection of water from one well to the other when switching from heating to cooling modes. However, the insensitivity of conventional water source heat pump coefficienct-of-performance to water source temperature resulted in a performance improvement of 3% or less compared to the conventional systems. Overall, the improvement in performance and resulting reduction in annual electrical costs was not enough to pay for the additional costs of the ATES system. 5 refs., 6 figs.

22388 **(SBI-Landbrugsbyggeri—69) Energy consumption and thermal environment in greenhouse nurseries.** Stroem, J.S. (ed.). (Statens Byggeforskningsinstitut, Hoersholm (Denmark)). 1987. 287p. (In Danish, Swedish, Norwegian). (CONF-8511348—). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm.

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

Results from ten years of research in the Nordic countries into energy consumption and energy saving in greenhouse nurseries were discussed at a seminar that was held at Tune Landboskole in Denmark from 11. through 15. November 1985. During the seminar a number of papers were presented, covering a wide range of tech-

nical, biological and economical topics. A total of 42 papers were on the agenda. In this report 34 reviewed papers are collected with the kind permission and cooperation of the speakers. During the editorial preparation of the report, the authors have had the opportunity to incorporate the results of the discussions taken during the seminar into their articles. Figures and tables have English titles and an English abstract has been included in each case. The building traditions and the major areas of research in Finland, Norway, Sweden and Denmark are presented. In spite of the close cultural relations between these countries, the technical solution to common energy saving problems often differ from country to country due mostly to differing tradition and legislation. In Finland, double skin structures seem to prevail, whereas rigid structures with twin walled pmma is the preferred solution. In Denmark, the traditional single glass building has been maintained, the energy saving being obtained by use of moveable screens and by lining exterior walls with a plastic film. Models for energy consumption and energy management are presented. Energy supply, heating installations, effects of architecture and materials on indoor climate and plant growth, and of plants on environmental control, in addition to possibilities of multidisciplinary interaction are discussed.

22389 (SBI-Landbrugsbyggeri—69, pp 167-174) **Chinks in greenhouses.** Stroem, J.S.; Froesig Nielsen, O. (Statens Byggeforskningsinstitut, Afdelingen for landbrugsbygninger, Hoersholm (DK); Statens Planteavlsforsoeg, Sektion for Gartneriteknik, Aarslev (DK)). 1987. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

The airtightness of greenhouses may be determined in two different ways: the delution rate of tracer gas or the air leakage during pressurisation. Both methods have been applied to five experimental greenhouses at the Horticultural Research Institute at Aarslev, Denmark. If the obviously most leaky greenhouses are effectualy sealed, single glass houses seem to be the most airthigt, probably due to tradition and good workmanship and sufficient overlays between the glasses (1-1,5 cm). The water film in the overlays was not broken, even at pressure differencials of 100 Pa. Access to the glass house were through sliding doors. At adequate positive pressure differences, the doors were forced outwards, leaving a crack area that were of the same size as the other crack areas in the greenhouses, i.e. 200 mm/sup 2//m/sup /surface area. The most airtight greenhouses turned out to be the single glazed houses. After extensive use of sealents the double glazed house would also be sealed. The most leaky houses were the double acryl houses, probably because of the covering material not being adapted to the construction system. (AB).

22390 (SBI-Landbrugsbyggeri—69, pp 183-189) **Plant production in greenhouses of different types.** Amsen, M.G.; Christensen. M.H. (Statens Planteavlsforsoeg, Sektion for Gartneriteknik, Aarslev (DK)). 1987. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

Energy consumption and production periods in greenhouses with different cladding materials, temperature - and humidity control strategies, watering and bench systems were investigated in two seasons in 1983 and 1984. Five experimental greenhouses were used of which two were covered with glass and thermal screen, two with twin walled pmma and one with double glass. The energy savings in the permanent insulated greenhouses were 20-30 pct. compared to the single glazed houses with thermal screen. The effects on production length for different potplants were small, with a tendency to slightly reduced production length in the permanently insulated greenhouses. The effect on plant quality was dependent on plant species. Energy consumption was slightly lower in insulated houses with dry benches as compared to wet benches. Energy consumption in single glazed greenhouses with thermal screens were not improved using reduced night/day temperature 17 deg. C/20 deg. C as compared to constant night/day temperature 18 deg.C/18 deg. C. The reduced night temperature did not influence the production time, except for Dieffenbachia and Ficus where it was reduced. Slatted benches resulted in significant energy savings as compared to wet benches in the single glazed greenhouses with energy screen. The production periods were in general unaffected by the bench type although Saintpaulia and Pilea were a little slower and Heder and Chrysanthemum slightly faster on the dry benches.

22391 (SBI-Landbrugsbyggeri—69, pp 190-199) **Humidity in greenhouses.** Boerjesson, L. (Sveriges lantbruksuniversitet, Inst. foer lantbrukets byggnadsteknik, Alnarp (SE)). 1987. (In Swedish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

To prevent problems with high humidity levels in the greenhouse air, it is necessary to analyse input and output of water vapour. The input consists of evaporation and transpiration and the output consists of air leakage, ventilation and condensation. The increase and the decrease of water vapour in the greenhouse air form a balance which is affected by different parameters of climate. The dew point temperature in comparison with the temperature of the ceiling, the fruit and the plant respectively shows when condensation takes place. These results can be summarized by figures 8-10 showing how often condensation took place during the growing period. Condensation on the ceiling during the nights took place about 90% of the growing period.

22392 **Magnetic heat pumps.** Hull, J.R.; Uherka, K.L. (Argonne National Lab., Argonne, IL (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889501.

Magnetic heat pumps and refrigerators are potential replacements for vapor-compression devices that use chlorofluorocarbon refrigerants. Several room-temperature designs, using low-temperature superconducting magnets, have reached the experimental device stage. High-temperature superconducting materials should significantly enhance existing design concepts and may enable new design approaches such as those involving field switching of superconducting magnets to accomplish the thermodynamic cycle.

22393 **Analysis of energy usage data for water heaters under load control.** Reed, J.H.; Khan, A.H.; Broadwater, R.P.; Chandrasekaran, A. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp v of Proceedings of the 1988 IEEE Southeastcon conference. Piscataway, NJ; IEEE Service Center (1988). (CONF-880433—).

From Southeastcon '88 conference and exhibit; Knoxville, TN, USA (11 Apr 1988).

The data obtained in the load control experiments on water heaters carried out on the Athens Utilities Board's Distribution System in Athens, Tennessee is analyzed and the diversified load patterns and energy usage determined. General conclusions about the effects of load control strategies on water heaters are made.

22394 **Analysis of appliance energy usage data from residential load control experiment.** Reed, J.H.; Oka, A.A.; Chandrasekaran, A.; Broadwater, R.P. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp v of Proceedings of the 1988 IEEE Southeastcon conference. Piscataway, NJ; IEEE Service Center (1988). (CONF-880433—).

From Southeastcon '88 conference and exhibit; Knoxville, TN, USA (11 Apr 1988).

The data obtained in the load control experiments on heat pumps and space heaters carried out on the Athens Utilities Board's distribution system in Athens, Tennessee is analyzed and the diversified load patterns and energy usage determined. General conclusions about the effects of load control strategies on heat pumps and space heaters are made.

22395 **Efficiency characteristics of speed-modulated drives at predicted torque conditions for air-to-air heat pumps.** Rice, C.K. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp v of Proceedings of the American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. 1988 winter meeting. Volume 94, Part 1. Atlanta, GA; American Society of Heating Refrigeration and Air Cond. (1988). (CONF-880128—).

From ASHRAE winter meeting; Dallas, TX, USA (30 Jan 1988).

Examples of system (motor plus inverter drive) efficiencies of two broad types of adjustable speed control are compared for predicted compressor and indoor blower load profiles. The two classifications are inverter-driven induction motors (IDIMs) and permanent-magnet electronically commutated motors (PM-ECMs). Reference sine-wave-driven induction motor (SWDIM) efficiencies are also given. The drive efficiencies are compared over a common set of predicted operating torque requirements for heating and cooling conditions. A modulating heat pump model was used to develop predicted reciprocating compressor torque / drive frequency mappings and the expected operating torque ranges. The variation in modulating compressor torque requirements is analyzed and the major determining factors examined. Ways to adjust the given torque relationships for different compressor types and sizing strategies are also discussed.

22396 **Laboratory testing of a heat pump system using an R13B1/R152A refrigerant mixture.** Vineyard, E.A. (Refrigeration Systems Group, Energy Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp v of Proceedings of the American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. 1988 winter meeting. Volume 94, Part 1. Atlanta, GA; American Society of Heating Refrigeration and Air Cond. (1988). (CONF-880128—).

From ASHRAE winter meeting; Dallas, TX, USA (30 Jan 1988).

Testing was performed with a nonazeotropic refrigerant mixture of R13B1/R152a to determine its ability to achieve (1) capacity control by adjusting the composition and (2) increased capacity, relative to R22, at low ambient temperatures. The selection of such a mixture could improve the efficiency of a heat pump by decreasing the cycling losses, which account for approximately 7-12% of the annual energy use, along with decreasing the amount of resistance heat required at low ambient temperatures. Results for the mixture show a potential capacity modulation from 12431 Btu/h (3643 W) at 17F (-8.3°C) to 8550 Bth/h (2506 W) at 47F (8.3°C) in heating and from 7451 Btu/h (2184 W) at 82F (27.8°C) to 9188 Btu/h (2693 W) at 95F (35°C) in cooling. An analysis of the coefficients of performance for the mixture and its pure components is presented along with a comparison against results obtained with R22. The comparison is based on maintaining equivalent inlet and exit water temperatures in the evaporator and condenser for both R22 and the mixtures.

22397 **In-situ appliance efficiency audit procedures.** Szydlowski, R.F.; Cleary, P.G. (Applied Science Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp v of Proceedings of the American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. 1988 winter meeting. Volume 94, Part 1. Atlanta, GA; American Society of Heating Refrigeration and Air Cond. (1988). (CONF-880128—).

From ASHRAE winter meeting; Dallas, TX, USA (30 Jan 1988).

A study was conducted to develop and field-test audit procedures that could be used in a large survey of in-situ appliance efficiencies. The appliances concerned were refrigerators, gas and electric water heaters, central air conditioners, and central gas furnaces. The efficiency indicators measured were compared too the manufacturers' rated values as determined by the California appliance standards procedures. The audit procedures field test involved 61 homes during summer 1986 and winter 1986-1987. Appliances were submitted to one-day short-term efficiency tests and one-week long-term monitoring of energy use and operational characteristics. The audit procedures were successful for refrigerators, the recovery efficiency of water heaters, and central gas furnaces. Water heater standby loss and air conditioner efficiency audit procedures are not practical at this time. An examination of alternative air conditioner audit procedures is advisable, whereas development of a practical audit procedure for measuring water heater standby loss is very unlikely. The successful audit procedures represent useful diagnostic tools that can be used in conjunction with all types of appliance end-use monitoring.

22398 **Laboratory efficiency comparisons of modulating heat pump components using adjustable speed drives.** Miller, W.A. (Oak Ridge National Lab. (US)). pp v of Proceedings of the American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. 1988 winter meeting. Volume 94, Part 1. Atlanta, GA; American Society of Heating Refrigeration and Air Cond. (1988). (CONF-880128—).

From ASHRAE winter meeting; Dallas, TX, USA (30 Jan 1988).

The operating efficiencies of an indoor centrifugal blower and a hermetic reciprocating compressor, both having induction motors, were measured in a breadboard heat pump test facility. The indoor blower was tested using a six-step voltage source inverter (VSI) produced in the early 1980s and also using a motor-generator (M-G) (ideal induction motor drive) for blower motor drive frequencies ranging from 20 to 60 Hz. The reciprocating compressor was driven in separate tests by a VSI, a pulse-width modulated inverter (PWMI), and an M-G to observe the effect of each adjustable-speed drive on the efficiency of the compressor for drive frequencies ranging from 15 to 90 Hz. Laboratory data indicated that the coefficient of performance (COP) of the heat pump and component efficiencies became increasingly sensitive to the magnitude of three-phase voltage input to the induction motors as drive frequency decreased from 60 to 15 Hz. A linear relation of volts per hertz yielded best compressor efficiency and thus best COP; however, for the indoor blower, the volts per hertz relationship was varied with speed for the best combination blower-and-blower-motor efficiency.

22399 **An overview of 3-D graphical analysis using DOE-2 hourly simulation data.** Haberl, J.; MacDonald, M.; Eden, A. (Oak Ridge National Lab. (US)). pp v of Proceedings of the American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. 1988 winter meeting. Volume 94, Part 1. Atlanta, GA; American Society of Heating Refrigeration and Air Cond. (1988). (CONF-880128—).

From ASHRAE winter meeting; Dallas, TX, USA (30 Jan 1988).

This paper presents an overview of a 3-D graphical approach for improving the potential of building energy analyses using the DOE-2 computer program. The approach produces 3-D annual profiles from hourly data generated by DOE-2 simulations using a statistical plotting package for specific quantities of interest. The annual profiles of hourly data provide a useful graphical check of voluminous data in a condensed form, allowing several different types of data to be plotted over a year. These profiles provide the user with the opportunity to check simulation results, check for potential problems with user input, provide graphs to customers who may want a simpler presentation, visualize interactions in simulations, and understand where inappropriate modeling conditions may exist in simulations. Future analysis, using such profiles, may allow methods to be developed to check consistency between simulations, check for potential hidden errors in modeling buildings, and better understand how simulations compare with data from real buildings.

22400 **Diagnostic techniques for evaluating office building envelopes.** Persily, A.K.; Grot, R.A.; Fang, J.B.; Chang, Y.M. (National Bureau of Standards (US)). pp v of Proceedings of the American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. 1988 winter meeting. Volume 94, Part 1. Atlanta, GA; American Society of Heating Refrigeration and Air Cond. (1988). (CONF-880128—).

From ASHRAE winter meeting; Dallas, TX, USA (30 Jan 1988).

A variety of diagnostic procedures exists for evaluating the thermal performance of office building envelopes. These measurement techniques enable the quantification of various aspects of envelope thermal performance including airtightness, thermal resistance, and insulation system performance. This paper describes several of these diagnostic measurement techniques in terms of instru-

mentation, test procedures, and data analysis. Representative measurement results are also presented for each technique. The techniques that are described include tracer gas measurements of air exchange rates, pressurization testing of whole building and component airtightness, thermal resistance measurements with calorimeter boxes and heat flux transducers, and infrared thermographic inspection.

22401 **The daylighting and thermal performance of roof glazing in atrium spaces.** Gillette, G.L.; Treado, S. (National Bureau of Standards, Gaithersburg, MD (US)). pp v of Proceedings of the American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. 1988 winter meeting. Volume 94, Part 1. Atlanta, GA; American Society of Heating Refrigeration and Air Cond. (1988). (CONF-880128—).

From ASHRAE winter meeting; Dallas, TX, USA (30 Jan 1988).

The effect of large areas of roof glazing in atrium spaces is assessed using site energy and peak demand loads as performance measures. Special attention is given to the role daylighting plays in the net performance of the glazing system. A detailed thermal transport and daylighting analysis computer program provided data on three aspects of roof glazing performance: the effects of the atrium alone, the atrium and its surrounding daylighting zone of influence, and the atrium and the coupled building as a whole. The results are presented in terms of comparative performance using a base case building configuration without glazing. The net change in performance due to the inclusion of the roof glazing is systematically evaluated. The results demonstrate the benefits of roof glazing on reducing the lighting energy requirements, and in turn, reducing site energy. These benefits, however, are tempered somewhat by the increased peak demand loads.

3202 Transportation

REFER ALSO TO CITATION(S) 22157, 22368, 22409

22402 **(DOE/CE—0210) Annual operating plan: Transportation energy conservation: Fiscal year 1989.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Transportation Systems). Dec 1988. 77p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008845/JAW.

The Office of Transportation Systems (OTS) is responsible for working with the private sector to improve the energy-use efficiency of the transportation sector and assist in the reduction of the sector's dependence on petroleum. The transportation sector currently uses over a quarter of all energy in the US and over 63 percent of all petroleum. In fact, the transportation sector currently uses 22 percent more oil than the US is able to produce. The goal of the Office is to improve the efficiency with which the sector uses petroleum and to enhance the flexibility of fuel use options in transportation-related technologies. This goal is underscored by the fact that such technologies have potentially significant leverage on the US and world oil situation. Reductions in US transportation oil use can enhance energy security, reduce oil imports and related trade payments to foreign countries, and enhance economic growth.

22403 **(NAL-TM—580) Update of drive unit for main blower in 2m*2m subsonic wind tunnel. Plan and construction.** Suzuki, Masamitsu; Toda, Nobuhiro; Komatsu, Ikuo; Karasawa, Toshio. (National Aerospace Lab., Chofu, Tokyo (Japan)). Feb 1988. 28p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757166/JAW.

The drive unit for main blower in the subsonic wind tunnel was updated in the National Aerospace Laboratory. The previous drive unit was composed of direct-coupled 18,000kW induction motor and 4,500kW d.c. motor and drived the main blower in the wind tunnel through the extended shaft. 25 years has passed since the previous drive unit was manufactured, resulting the remarkable deterioration. The whole unit was simplified by converting to the single driving system with a thyrister motor from the previous combined driving system. As the result, the power consumption per each Mach can be saved by about 2,300kW. The vibration of shafts in the main blower does not occur because the torque pulsation of the motor was reduced by employing series polyphase system of thyristor converter. Higher harmonics generating from the thyristor converter shows better results by applying higher harmonic filters. The full automatic operation could be realized by using the operation control system to eliminate the difficult operation from operators. (19 figs, 3 tabs, 7 refs)

22404 **(NAL-TM—585) Effects of coolant injection on turbine aerodynamic characteristics (Part 1). Test turbine and apparatus.** Inoue, Shigeo; Usui, Hiroshi; Minoda, Mitsuhiro; Nose, Hiroyuki. (National Aerospace Lab., Chofu, Tokyo (Japan)). May 1988. 21p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757168/JAW.

A turbine aerodynamic rotating test apparatus was prepared to improve the turbine aerodynamic characteristics of highly efficient gas turbine. This appatus was designed and fabricated so that the aerodynamic tests can be made in the practical Mach numbers by using compressed air supplied from the existing air supplying equipment (1,800kW axial compressor, 250kPa discharging pressure, 18kg/s flow rate and 400K discharging air temperature). The test apparatus incorporates first stage stator blades and rotor blades in the high pressure turbine of a gas turbine for an airoplane and the shroud ring at the tip part of rotor blades contains air injecting holes through which secondary air can be injected. Tests were carried out to confirm effects of coolant injected from following parts on turbine aerodynamic characteristics: (1) stator blades, (2) both stator and rotor blades, (3) stator casing, and (4) rotor casing(shroud ring). (23 figs, 8 tabs, 6 refs)

22405 **(NAL-TR—958) Conceptional design study of USB powerd Lift aircrafts in FY 1986.** Takazawa, Kingo. (National Aerospace Lab., Chofu, Tokyo (Japan)). Jan 1988. 56p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88757169/JAW.

The conceptional design of aircrafts applying the thechnology of USB powered lift force was made. The authors put emphasis on this application to the regional transport, for which the aircrafts of both land based and amphibian types were fixed in criteria to have 50 seats with 1,111 km of flight range and 40 seats with 926 km of flight range, respectively. The possibility of applying the above USB technology to both the large/medium sized and regional transport aircrafts was presumed with calculation by using the CAD program. As a result of this presumption, the CTOL aircraft, engined with approx. 6 in engine's bypass ratio, is known to be, in case of regional transport aircrafts, excellent in required runway and direct operational cost. In case of twin-engined aircrafts, the cross shafting system is advantageous to the heightening in safety. The adoption of common aircraft structure for both the land based and amphibian types is good for the lowering in manufacturing cost. The improvement in progressive air navigation method for the twenty-first century was also studied. (26 figs, 22 tabs, 69 refs)

22406 **(NAL-TR—959) Experimental study on high pressure liquid oxygen pump.** Watanabe, Mitsuo; Hasegawa, Satoshi; Kamijo, Kenjiro; Aoki, Hiroshi. (National Aerospace Lab., Chofu, Tokyo (Japan)). Feb 1988. 13p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757170/JAW.

In order to improve the performance of high pressure liquid oxygen and liquid hydrogen rocket engines, a small high pressure liquid oxygen pump was designed, fabricated and tested. The adjustment tests and the high loading tests were carried out in the National Aerospace Laboratory and the National Space Development Agency, respectively. In the adjustment tests liquid nitrogen was used as a pump fluid, and in the high loading tests liquid nitrogen and liquid oxygen were used. The tests conditions are as follows; maximum rotational speed of 45000 rpm and maximum delivery pressure of 180 ata for liquid nitrogen, 35000 rpm and 150 ata for liquid oxygen. The pump efficiencies were 60 % and more in the design flow rate and were relatively high, the pump head was shown about 2200m at 45000 rpm and it was about the design value. The pressures of main parts in the pump had few rotational speed dependency except the case with very low rotational speed.

At the design rotational speed of 45000 rpm, the shafting showed a very stable condition, and the bearing and seal systems also showed excellent performances. (19 figs, 2 tabs, 8 refs)

22407 **(NAL-TR—963) Performance of small high speed rocket pumps.** Watanabe, Yoshiaki; Watanabe, Mitsuo; Kamijo, Kenjiro. (National Aerospace Lab., Chofu, Tokyo (Japan)). Mar 1988. 12p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757172/JAW.

A performance study of small high speed cryogenic rocket pumps has been carried out. These pumps were made for use with liquid oxygen and liquid hydrogen feed pumps, they were single-stage with inducer or two-stage centrifugal pumps. Water, liquid oxygen, liquid nitrogen and liquid hydrogen were used for the tests as the pump fluids. The maximum pump efficiencies are shown by 68 to 69%, they are considerably higher values with the small size pumps due to improved volumetric efficiencies through reducing ring seal clearance. The pump efficiencies regarding the kinds of the fluids are in order of water < liquid nitrogen < liquid hydrogen, this is due to decreasing disc friction losses. Rotating speed has little effect on the efficiency. The relations between the pump efficiencies and the suction specific speeds per stage were all higher than that of the literature data in considering outer diameter of main impeller, especially the two-stage centrifugal pump showed higher efficiency. Excellent suction performances were shown through these pumps due to the thermodynamic effects for the cavitation. Even in the case of almost saturated state at the pump suction, sufficient suction performance were confirmed. (16 figs, 2 tabs, 15 refs)

22408 **Method of processing materials using an inductively coupled plasma.** Hull, D.E.; Bieniewski, T.M. (to Dept. of Energy, Washington, DC). US Patent 4,795,879. 3 Jan 1989. Filed date 13 Apr 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method is described for coating a surface in a gas-free environment using an electrically conductive ceramic or metal coating material which is initially in solid form comprising: a. providing inductively coupled plasma apparatus comprising: (1) an electrical induction coil having a central longitudinal axis; (2) a dielectric tubular enclosure centered coaxially on the axis and located inside the coil; (3) a segmented metal radiation shield which is grounded and centered coaxially on the axis inside the enclosure, the shield consisting of elongate fluid-cooled metal shield segments extending parallel to the axis, the segments being in a circular arrangement adjacent the interior surface of the enclosure and being equally spaced such that the shield has a generally tubular configuration, and the shield segments being shaped in cross section so as to occlude line-of-sight transmission of light through the radiation shield; and (4) an outlet for the coating material; b. placing the coating material within the radiation shield; c. evacuating the tubular enclosure; d. heating the coating material by use of the induction coil to vaporize the coating material and to form a plasma from the resulting vapor; and e. providing the surface adjacent to the outlet of the plasma apparatus, in order that material emanating from the outlet is deposited on the surface.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 21642, 21647, 21891, 22280, 22354, 22379, 22379, 22380, 22381, 22381, 22382, 22382, 22383, 22383, 22387, 22459, 22459, 22654, 22827, 23069

22409 **(AFME-Z—0090) AFME 1988-1992 R and D program.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1988. 247p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88757219/JAW.

The French Energy Conservation Agency (AFME) research and development program for the 1988-1992 is described; the main objectives are the energy conservation in the industry (improvement of the energy efficiencies of the industrial processes, of the heat exchangers and of the combustion processes), the energy conservation in transport (non-polluting and energy-efficient engines, circulation traffic aid systems), and the raw materials conservation (metallic ores and half-finished products, wood). A relatively small priority is given to energy conservation in buildings.

22410 **(CONF-890402—1) Atmospheric fluidized-bed cogeneration air heater experiment.** Klein, A.; Natesan, K.; Podolski, W.F. (Argonne National Lab., IL (USA)). 25 Oct 1988. Contract W-31109-ENG-38. 20p. NTIS, PC A03 - OSTI. Order Number DE89003940/JAW.

From 10. international conference on fluidized-bed combustion; San Francisco, CA, USA (30 Apr 1989).

The US DOE-sponsored Atmospheric Fluidized-Bed Cogeneration Air Heater Experiment (ACAHE) is intended to assess the performance of various heat exchanger materials in order to establish confidence in the resultant designs of fluidized-bed combustion (FBC) air heater systems. Westinghouse and its subcontractors have specified test conditions and provided test article hardware for the ACAHE. Argonne National Laboratory through a contract with Rockwell International is conducting the tests in the DOE 1.8 m {times} 1.8 m (6-ft. {times} 6-ft) AFBC facility in El Segundo, California. This paper presents an overview of the project, a description of the facility and the test hardware, the test operating conditions, a summary of the operation over the first 1000 h. 3 refs., 8 figs., 2 tabs.

22411 **(DOE/CE/40606—T7) Ultrafiltration of kraft black liquor: Final report, Phase 3.** Hill, M.K. (Maine Univ., Orono (USA)). Apr 1988. Contract AC02-82CE40606. 61p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008221/JAW.

Since 1981, a research program has been in progress to determine the physical properties of kraft black liquors and to develop methods for reduction of data and correlation of properties with pumping conditions. The basic premise that has been used to direct the research program is that kraft black liquor behaves as a polymer solution, particularly at high solids, and that the behavior is dominated by the characteristics of the lignin present. This premise is proving to be correct, and the principles that follow from this premise are proving to be successful for data reduction and correlation. The research has been a complex program involving experimental pulping, chemical analysis, lignin separation and characterization, thermal analysis, rheological measurements, and considerable equipment and methods development. Due to the complexity of the program, the unforeseen need to expend a great deal of effort in development of experimental techniques for analysis, and the fact that our liquors proved to be unstable at high temperatures and solids, all of the original objectives could not be accomplished. However, our program has added substantially to the body of knowledge of physical properties of black liquor. Our results indicate that the goal of developing correlations for physical properties of kraft black liquor is practical and can be realized through extension of the present work. 21 refs., 32 figs.

22412 **(DOE/ID—10208-App.L) Techno-economic assessment of a carbothermic alumina reduction process: Appendix L, Optimistic cost estimates for carbothermic reduction.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jan 1989. Contract AC07-76ID01570. 36p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008052/JAW.

A techno-economic assessment of a process for the carbothermic reduction of alumina based on prior work and a flowsheet developed by a technical committee for the US Department of Energy is described. Estimates indicated that one could expect operating costs for a new carbothermic plant at $0.44-$0.45/lb of aluminum vs. $0.52 in a conventional plant using Hall cells based on conditions prevailing in mid-1988. This savings may not be sufficient to interest a new producer for new plant construction in the US considering the availability of aluminum from overseas facilities favorably situated to produce aluminum in the cost range of $0.35--$0.40/lb. The objective of this effort was to undertake optimistic estimates for capital investments and operating costs for the carbothermic reduction of alumina based on the flowsheet described in the body of this report. Estimates were to be of preliminary nature based on engineering judgment, discussions with industry personnel, and equipment suppliers. The results are presented here in Appendix L. The body of report is referenced continuously throughout the following text. Three Addenda are included at the end of Appendix L. 5 refs., 1 fig., 7 tabs.

22413 **(DOE/ID/12302—9) Fluidized-bed waste-heat recovery system development: Final report.** Patch, K.D.; Cole, W.E. (TECOGEN, Inc., Waltham, MA (USA)). Jun 1988. Contract FC07-81ID12302. 386p. NTIS, PC A17/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006888/JAW.

A major energy loss in industry is the heat content of the flue gases from industrial process heaters. One effective way to utilize the energy, which is applicable to all processes, is to preheat the combustion air for the process heater. Although recuperators are available to preheat this air when the flue gases are clean, recuperators to recover the heat from dirty and corrosive flue gases do not exist. The Fluidized-Bed Waste-Heat Recovery (FBWHR) system is designed to preheat this combustion air using the heat available in dirty flue gas streams. In this system, recirculating alumina particles are heated by the flue gas in a raining bed. The hot particles are then removed from the bed and placed in a fluidized bed where they are fluidized by the combustion air. Through this process, the combustion air is preheated. The cooled particles are then returned to the raining bed. Initial development of this concept is for the aluminum smelting industry. In this final report, the design, development, fabrication, and installation of a full-scale FBWHR system is detailed.

22414 **(DOE/OSTI—3409) The Office of Industrial Programs technical reports: A bibliography.** Blackburn, P.S. (comp.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Oct 1988. 80p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE88006687/JAW.

This bibliography is the first annotated publication containing information on all scientific and technical reports sponsored by the DOE Industrial Energy Conservation Program during the years 1974--1987. The abstracts are grouped by program subdivision as shown in the Contents. Cross categorization is provided when the report covers more than one topic. Within each group, arrangement is alphabetized by report number in reverse chronological order. Interim progress reports have been excluded when there is a final report on the project.

22415 **(NP—9770297) Efficient energy utilization in an integrated steel mill by recovering and using CO-gas - BOF-shop I Bruckhausen. Final report.** Auth, R.; Wiesten, M.; Gierig, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1988. 49p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770297/JAW.

The main intention of developing a process for recovering and using the off-gas from converters in BOF-shops was the saving of primary energy. For this purpose the 2 converters at the BOF-shop Bruckhausen with a tapping weight of 380 t have been equipped with a Lurgi-Thyssen plant for collecting, cooling and dedusting the off-gas generated during the blowing period in the converters. The off-gas is cooled in a waste-heat boiler. In this process steam is generated that is used in different mill facilities. The recovered CO-gas is stored in a gasholder and conveyed from the gasholder by a pressure booster fan. To distribute the gas an existing tube system is used so that the CO-gas can be utilized in different mill facilities. In addition to energy recovery, the environmental protection was improved by reducing dust and waste heat emissions. (orig.) With 18 refs., 3 tabs., 24 figs.

22416 **(NP—9770302) Determination of temperature strategies for greenhouse cultures by means of bio-economic models and numerical search procedures.** Lentz, W. (Hannover Univ. (Germany, F.R.). Fakultaet fuer Gartenbau und Landeskultur). 1 Jul 1987. 245p. (In German). NTIS (US Sales Only), PC A11. Order Number DE89770302/JAW.

The paper first of all points out possibilities and limits of formal models as decision aids in plant breeding and devises a partial model for the growing of vegetables under glass. This partial model was an attempt to unite knowledge about plant growth with the possibilities of regulating greenhouses (suitable heating strategy). Furthermore the study investigated by practical comparison whether numerical methods are suited to optimize bio-economic models. Individual parts of the report deal with the bases of qualitative models for the trade and quantitative models to aid decision-making, as well as with a bio-economic simulation model (plant growth, greenhouse climate, heating energy), numerical optimation (special search procedures), and model calculation (temperature control). (HWJ).

22417 **(NP—9770314) Purification of waste gas behind container-glass-tanks. Final report.** Abraham, D.; Raithore, P. (Oberland Glas A.G., Bad Wurzach (Germany, F.R.); Umweltbundesamt, Berlin (Germany, F.R.)). 1986. 123p. (In German). NTIS (US Sales Only), PC A06. Order Number DE89770314/JAW.

By using the principle of dry sorption the emissions of dust particles, SO/sub x/, gaseous fluorides and chlorides in waste gas will be reduced by rejecting the filtrates from a horizontal electrostatic precipitator with two electrical fields, which are coming out of three heavy oil or heavy oil/gas fired container glass melting tanks. Calcium hydroxide powder will be blasted through a nozzle into the waste gas horizontal pipe. It reacts besides with gaseous contaminations in a vertical reacting tower because of high turbulence. The reaction activities will be intensified by spraying water. The waste gas is cleaned up to maximum of 20 mg/m/sup 3/ of dusts. The pollution contaminations are less than in TA-Luft 1986 (Clean Air Technical Code). The filtrates are pelletised for better handling. It is also provided for recycling the dust into glass. (orig.) With 23 refs., 47 tabs., 3 figs.

22418 **(NP—9770321) Concept for the exploitation of waste material from coal-fired power stations. Pt. 1. Gypsum from flue-gas desulfurization.** (Vereinigung Deutscher Elektrizitaetswerke e.V. (VDEW), Frankfurt am Main (Germany, F.R.); VGB Technische Vereinigung der Grosskraftwerksbetreiber e.V., Essen (Germany, F.R.); Bundesverband der Gips- und Gipsbauplattenindustrie e.V., Darmstadt (Germany, F.R.)). Mar 1986. 18p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770321/JAW.

The electricity industry and gypsum industry associations have jointly taken up the requirement for exploitation from within the environmental protection laws. They have evolved an exploitation concept for REA-gypsum, which is obtained in flue-gas desulfurization plants. On the basis of realistic statistics from the participating partners, the power station operators and gypsum and cement industry firms, the amounts occurring are compared with exploitable amounts. The necessity for preparation, transport, short-term storage and final delivery is described. It is jointly established that: REA-gypsum is a raw material equal in value to natural gypsum. REA-gypsum will not completely replace natural gypsum. REA-gypsum will have to find new areas of application. REA-gypsum from black coal power-stations can be exploited on a long-term basis. In this way the legal requirements for the protection of the environment can be met through constructive cooperation in industry.

22419 (NP—9770326, pp 129-134) **Pilot project: Solid manure collector.** Koch, H. [1984]. (In German). NTIS (US Sales Only), PC A08. Order Number DE89770326/JAW.

In Agriculture in Hessen. Hessian Land programme for promoting the development of renewable energy sources and their use in agriculture.

The energy amount of 7000 kWh/year needed for office and service water heating can be supplied by the collector using solid manure from pigs has led to a saving of heating costs of about 1.100 DM.

22420 **(NUKEM-FuE—86010) Chemical decomposition of higher halogenated hydrocarbons on a semi-industrial scale. Phase 2. Final report.** Demmich, J.; Muller, H. (Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Hanau (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1987. 101p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88757388/JAW.

A report is presented on a recent procedure for the chemical-thermal decomposition of highly chlorinated and other halogenated hydrocarbons, as an alternative to the current practice of off-

shore incineration; the effectiveness of the procedure was tested within the framework of a development project of NUKEM Ltd., Hanau, subsidized by the Federal Minister for Research and Technology and supported by the Hessische Industriemuell Ltd., Wiesbaden. With the decomposition of halogenated hydrocarbons in the presence of reactive reagents rendered bondable for halogens on the basis of calcium, the formation of metabolites such as polychlorinated dibenzodioxins and dibenzofuranes is precluded in the absence of oxygen and at temperatures of 600-800/sup 0/C. The decomposition results in a solid residue composed of carbon, calcium halide and a superstoichiometrically applied reactant, as well as a readily combustible waste gas free from organic halogen compounds.

22421 **(ORF/ES—NRC26195) Review of Heat Pump Program.** (Ontario Research Foundation, Mississauga (Canada). Energy Systems Centre). 1987. 205p. (In French). (MICROLOG—88-04458). National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, Ont., Canada K1A 0R6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A history and a summary of the highlights of the National Research Council of Canada's Heat Pump Program is presented in the introduction to this review. Summaries are then provided of individual research and demonstration projects. In the industrial sector, these projects included: the use of chemical heat pumps in distillation, extraction, and steam generation; heat recovery in the dairy industry; drying of paper, grain, and wood; process water heating in restaurants and laundries; boiler feedwater preheating; and cooling the water in storage tanks for lobsters. In the residential sector, projects included studies on performance, economics, energy consumption, and heat sources of heat pumps; application and demonstration of heat pumps in space heating, water heating or preheating, and exhaust air heat recovery; and development of residential heat pumps for use in Canadian conditions. Under each project are discussed the project's objectives, overall design, performance, economic benefits if any, and recommendations for possible improvements. A list of project reports is included. 50 refs., 58 figs., 15 tabs.

22422 (SBI-Landbrugsbyggeri—69, pp 13-17) **Greenhouse nurseries and energy economy in Finland.** Kaukovirta, E. (Helsingfors universitet, Institutionen foer traedgaardsvetenskap, Helsingfors (FI)). 1987. (In Swedish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

The total greenhouse area in Finland was 360 ha in 1984 of which 2/3 were used for growing vegetables and 1/3 for flowers. The energy consumption per unit area was 50% higher for flowers than for vegetables. Oil was the predominant fuel providing 88% of the consumption. Single glass is the preferred cover material for greenhouse, although 20% of new houses are covered with double acryl. Greenhouses with double plastic sheets are used more frequently in Finland than in the other Nordic countries. Introduction of computers in commercial nurseries is gaining momentum supported by research e.g. "the speaking plant" project.

22423 (SBI-Landbrugsbyggeri—69, pp 18-24) **Greenhouse nurseries in Norway; development, energy conditions, subjects for research.** Stroemme, E. (Institutt for blomsterdyrking og veksthusforsoek, Aas-NLH (NO)). 1987. (In Norwegian). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

The greenhouse area in Norway has been constant for some years and amounts to about 180 ha. A little more than half of it is used for vegetables, the rest for flowers. Pot plant production has increased remarkably the last few years. The greenhouse production in Norway is characterized by a. Regulation of import which basically is meant to give Norwegian produce priority on the domestic market when conditions are favourable for Norwegian production. b. An agricultural policy which substains agricultural activities in all parts of the country. c. Transfer of resources for the initiation of energy saving measures. d. Access to relative cheap electric energy. e. A rapid increase in the use of artificial light in greenhouses. f. A rapid turnover from single glass to double cladding, especially to double acrylic. Research has been carried out on a. Reduction of heat loss (screens, double cladding etc). b. Heating systems (air vs. hot water). c. Optimizing of growing conditions by means of supplementary irradiation, CO/sub 2/ injection, and proper temperature management. d. Absorbing long wave irradiation by means of copper sulphate solution circulating in the greenhouse roof with the object of reducing heat load and extend the period for CO/sub 2/ injection.

22424 (SBI-Landbrugsbyggeri—69, pp 25-33) **Attempts to reduce energy costs in Swedish greenhouse horticulture.** Landgren, B. (Sveriges Lantbruksuniversitet, Inst. foer lantbrukets byggnadsteknik, Alnarp (SE)). 1987. (In Swedish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

The statement of methods for reducing energy-costs in Swedish greenhouse-technique during the last decade takes into consideration steps to decrease the energy demand as well as alternative energy sources. The definite futural development in Sweden will first of all be dependent on governmental policy rather than new technical experiences. (author) 19 refs.

22425 (SBI-Landbrugsbyggeri—69, pp 34-39) **Energy research and energy consumption in Denmark.** Amsen, M.G. (Sektion for gartneriteknik, Institut for Vaeksthuskulturer, Aarslev (DK)). 1987. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

The total heated greenhouse area was 441 ha in 1982 of which 52% was for growing potplants, 29% for vegetables and the rest for cut flowers. Since 1972 the area for growing pot plants has increased by 23% while vegetables were reduced by 30% and outflowers by 63%. Energy consumption per m/sup 2/ greenhouse floor area has been reduced by 41% from 1972 to 1982. Research into energy consumption within horticulture has primarily been carried out at the Institute for Glasshouse Crops on the biological effect of energy saving technics and at the Danish Building Research Institute on energy consumption profiles in commercial nurseries. The most common energy saving measures has been sealing off the greenhouse, insulating the gables and walls with plastic films, and applying shading screens during the night. Furthermore research has shown, that lowering the night temperatures is uneffective.

22426 (SBI-Landbrugsbyggeri—69, pp 43-55) **Energy data for commercial plant nurseries.** Stroem, J.S.; Kristensen, K. (Statens Byggeforskningsinstitut, Afdelingen for Landbrugsbygninger, Hoersholm (DK); Statens Planteavlsforsoeg, Dataanalytisk Laboratorium, Lyngby (DK)). 1987. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

On the basis of energy signature for a greenhouse nursery it is possible to distinguish between energy consumption caused by weather and room temperature on one side and the technical standard of the nursery on the other. The energy signature in its simplest form is the linear representation of the energy consumption as a function of the outdoor temperature. The slope of the energy signature, the energy coefficient, is a characteristic number expressing the technical standard of a nursery. It may therefore be used for meaningful comparisons between nurseries. It is required, though, that the spread of data around the signature is small. This will normally be the case for a nursery where room temperatures are kept constant. A large spread of the data, as expressed by a small r/sup 2/, may be explained by the nursery having different cultures and thus different room temperature levels through the year. Seperate, parallel signatures may then be established for each temperature level. As the basis for the evaluation of a nursery's technical stand-

ard, an energy coefficient of 6-7 W/m/sup 2/ deg. C was found reasonable for a nursery community having 52 nurseries with 343.400 m/sup 2/ under glass. The energy coefficient was computed using glass covered area and not surface area that normally is taken as 1.5 times larger. (author) 12 refs.

22427 (SBI-Landbrugsbyggeri—69, pp 56-67) **Statistical methods for evaluating energy technology in relation to greenhouse nurseries.** Kristensen, K.; Stroem, J.S. (Statens Planteavlsforsoeg, Dataanalytisk Laboratorium, Lyngby (DK); Statens Byggeforskningsinstitut, Afdelingen for Landbrugsbygninger, Hoersholm (DK)). 1987. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

The parameters of models to describe the energy consumption of a greenhouse nursery are estimated by linear and non-linear regression analysis. In the model temperatures, wind speed and solar radiation were included as 1: week-ly means or 2: weekly means excluding temperatures and solar radiations unimportant to energy consumption. The residual standard deviation ranged between 15.0 and 17.4 w/m/sup 2/, when varying temperature in the greenhouses and one or more of parameters describing the weather were used.

22428 (SBI-Landbrugsbyggeri—69, pp 68-76) **Energy management.** Skov, O. (Statens Byggeforskningsinstitut, Afdelingen for Landbrugsbygninger, Hoersholm (DK)). 1987. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

Energy management is a method to ensure that the energy consumed in a greenhouse nursery can be accounted for. This is done by measuring the energy consumption on a weekly or monthly basis and compare the measured consumption with a theoretical consumption. The theoretical consumption is calculated on the basis of the technical standard of the nursery, control strategies and weather. The theoretical consumption is an estimate of the energy that should be sufficient to heat the nursery. A measured value in excess of the theoretical value is an indication of unnecessary waste. A method for easy calculation of the theoretical consumption is given. In order to keep energy waste at a minimum, the energy management should be organized as an integral part of the nursery management. Every time energy related changes take place in the nursery, the theoretical energy consumption should be adjusted accordingly. (author) 10 refs.

22429 (SBI-Landbrugsbyggeri—69, pp 77-84) **Statistical model for data on the energy balance in greenhouses.** Nilsson, G. (Sveriges lantbruksuniversitet, Inst. foer lantbrukets byggnadsteknik, Alnarp (SE)). 1987. (In Swedish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

When using the computer program EBBE, it is possible to study both single and multi-span greenhouses regarding incidence of solar energy, energy losses, necessary supply of energy and surplus of energy. Measurements show that the model, which is static and supplied with an outside average climate as input, gives acceptable information about energy and power demand in greenhouses. If the climate is calibrated to the measured climate it gives a good agreement with measured results during a certain period.

22430 (SBI-Landbrugsbyggeri—69, pp 87-95) **Fossil fuels.** Nielsen, V. 1987. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

Fossil fuels that are used for the heating of greenhouse nurseries are primarily coal, oil and natural gas. Properties of these fuels are summarized and the application to greenhouse heating discussed. The choise of fuel is primarily a matter of economy, but factors such as reliability, easy operation and air pollution may be taken into account. Technically natural gas is the most and coal the least suitable fuel for greenhouse nurseries. (author) 11 refs.

22431 (SBI-Landbrugsbyggeri—69, pp 96-101) **Electric power for lighting systems, space heating and heat pumps.** Virhammar, K. (Lantbruksnaemndens traedgaardsavdeling, Goeteborg (SE)). 1987. (In Swedish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

The availability of relatively cheap electricity has made use of artificial lighting, electric heating and heatpumps economically feasible to commercial greenhouse nurseries in Sweden. The introduction of interuptable power has enhanced this development.

22432 (SBI-Landbrugsbyggeri—69, pp 102-110) **Heat pumps.** Stene, J. (Statens Fagtjeneste For Landbruket, Stjoerdal (NO)). 1987. (In Norwegian). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

The rentability of a heat pump installation depends on the type of system that is used for reference. The most common fuel for greenhouse heating in Norway is light oil no 2 costing Nkr 2,10 per litre. The other important factor in rentability calculations for heat pumps is cost of electrical energy, in our case estimated at Nkr 0,25 per kWh. Water-to-water and air-to-air heat pump installations were investigated throug 1984/85 in two greenhouse nurseries. The results were promising. The heating cost were nearly reduced 50% and the payback time were 3 to 4 years. In spite of the good results, the gardeners are reluctant to accept heat pumps as a general heat supply system to their nurseries. Other heat saving measures or other investments may have given equal or better results.

22433 (SBI-Landbrugsbyggeri—69, pp 111-116) **Alternative energy sources.** Gustavsson, G. (Sveriges lantbruksuniversitet, Inst. foer lantbrukets byggnadsteknik, Alnarp (SE)). 1987. (In Swedish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

A low energy prototype for conditioning of greenhouse, has been developed at LBT:s research plant in Alnarp. It has mainly been based on energy conservation and use of alternative energy sources. Preliminary results from the prototype system were: Energy consumption were 85-90% lower than in a single glazed greenhouse. More accurate control of temperature, air humidity, radiation and CO/sub 2/ were obtained in the prototype system than in the reference house. Preliminary evaluation of the research work and the experiences from application to a commercial nursery point to an economical advantage compared to conventional conditioning techniques.

22434 (SBI-Landbrugsbyggeri—69, pp 119-126) **Hot-water heating systems.** Nielsen, V. 1987. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

During the 1950-ties heating of greenhouses changed from low pressure steam to hot water systems. The basis for the change was the introduction of automatically controlled mixing valves and the use of circulating pumps. In the paper guidelines are given for the design of hot water systems in greenhouse nurseries having their own boiler. The main steps covered are: Design heat load; type, size and distribution of heating surfaces; size of circulating pumps, distributing pipes and mixing arrangements; size of main pumps and main pipes; control of main pumps. (author) 10 refs.

22435 (SBI-Landbrugsbyggeri—69, pp 127-134) **Air-heating system in greenhouses.** Sebesta, Z. (Institutt for blomsterdyrking og veksthusforsoek, Norges landbrukshoegskole, Aas (NO)). 1987. (In Norwegian). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

An air-heating system was compared to a pipe-heating system. The experiments were performed in two identical houses covered with double acryl. The two greenhouses were both outfitted with the two different heating systems. The heating systems were alternated between the two houses each week. Tomato plants were carried from one house to the other in order to have the same type of heating throughout their whole growing period. Measurements of the heat consumption, temperature, air velocity, evaporation and soil temperature were performed.

22436 (SBI-Landbrugsbyggeri—69, pp 135-140) **Underground heat storage.** Gustavsson, G. (Sveriges lantbruksuniversitet, Inst. foer lantbrukets byggnadsteknik, Alnarp (SE)). 1987. (In Swedish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

The testing of a soil heat storage system installed in a greenhouse at the Institute for Farm Buildings in Alnarp, Sweden, showed that small scale soil heat storage gives too much energy loss and that effective use of surplus energy in greenhouses relies on the accuracy of thermal storage design. Yet heat storage permits precise temperature control since the surplus energy can be stored. Thus the time that the louvres had to be opened for ventilation purposes, (in order to balance energy consumption) was reduced. The dimensions of the heating system can be reduced, and the system made more effective, by accurate use of thermal storage, and energy consumption will remain more stable. Soil heat storage helps reduce damage to plants should the greenhouse's power supply be temporarily cut off. (AB).

22437 (SBI-Landbrugsbyggeri—69, pp 143-151) **Alternative glazing materials.** Landgren, B. (Sveriges Lantbruksuniversitet, Inst. foer lantbrukets byggnadsteknik, Alnarp (SE)). 1987. (In Swedish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

Aging tests of glass- and plastic-covers for greenhouses have been carried out as laboratory tests at our institute ever since 1966. After the energy-crisis in 1973/74 the interests in Sweden have been concentrated on insulated greenhouse covers as an alternative to common single glass. Of current interest are double or triple rigid acrylic, polycarbonate (with or withour acrylic-coating), double-skinned EVA, Sedo-glass, Hortiplus and different types of thermal screens. All the new materials give some alternations in the greenhouse climate. A heat saving of 35-40% for double-skinned houses must normally be related to a light loss of 8-15%, according to our experiences.

22438 (SBI-Landbrugsbyggeri—69, pp 152-160) **Saving energy in different types of greenhouses.** Froesig Nielsen, O.; Amsen, M.G. (Statens Planteavlsforsoeg, Sektion for Gartneriteknik, Aarslev (DK)). 1987. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

The heat consumption number is defined as the heat consumption per deg. C temperature difference per m/sup 2/ surface area. It is strongly dependent on season, on day or night, and on the covering material. Permanent insulation using double glass or double acryl will not only reduce the heat requirement, but also the diurnal heat requirement as compared with a non insulated greenhouse. The heat consumption of a single glazed greenhouse with insulating screens is the same during night as a greenhouse with doble glass or double acryl.

22439 (SBI-Landbrugsbyggeri—69, pp 161-166) **Climate in varying greenhouse types.** Amsen, M.G.; Nielsen, O.F. (Statens Planteavlsforsoeg, Sektion for Gartneriteknik, Aarslev (DK)). 1987. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

Major data on environmental parameters are presented from 5 experimental greenhouses, which differ in cladding material or type of benches. Permanent insulation resulted in higher humidity and higher leaf temperatures in day time. With a first priority on the bottom heating the pipe temperature of the top heating system was lower. Slatted benches showed, at equal room temperatures, lower leaf temperatures and humidity, as compared to traditional, closed benches. Flooded benches did not result in a lower humidity as compared to traditional capillary benches.

22440 (SBI-Landbrugsbyggeri—69, pp 175-180) **Asymmetric greenhouses.** Nilsson, G. (Sveriges lantbruksuniversitet, Inst. foer lantbrukets byggnadsteknik, Alnarp (SE)). 1987. (In Swedish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

An asymmetric greenhouse, shown in fig. 1, with an insulated, high reflecting and non transparent north wall, has a higher light level compared to a symmetric greenhouse with or without a transparent north wall, disregarded from cloudy days with an insolation less than 100 W/m/sup 2/ in the greenhouse. The amount of energy saving achieved by the bulding being asymmetric in design, (as shown) when compared to a symmetrically designed greenhouse (both having an insulated north wall) depends on the type of insulation. (AB).

22441 (SBI-Landbrugsbyggeri—69, pp 200-204) **Lighting conditions and plant growth.** Andersson, N.E. (Statens Planteavlsforsoeg, Sektion for Gartneriteknik, Aarslev (DK)). 1987. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

Hibiscus rosa-sinensis does not grow and develop very well during winter. In an experiment the effect of artificial light during night was investigated. The total photoperiod was 18 hours and the prolonging of the natural day ranged from 6 to 11 hours. Using 30 and 60 μmol m/sup -2/s/sup -1/ increased the number of sideshoots and the numbers of leaves. The number of sideshoots was equally increased in both light treatments, but 60 μmol m/sup -2/s/sup -1/ increased the number of leaves with 88 per cent as compared to plants grown under natural light conditions only.

22442 (SBI-Landbrugsbyggeri—69, pp 207-213) **Computer-based model for energy consumption calculations in relation to greenhouses.** Haakansson, B. (Sveriges Lantbruksuniversitet, Avd. foer traedgaardsekonomi, Alnarp (SE)). 1987. (In Swedish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

A computer-based model for energy consumption calculations for greenhouse nurseries is presented. The results are used as a basis for economic evaluations of running costs and the feasibility of energy-saving investments. (author) 10 refs.

22443 (SBI-Landbrugsbyggeri—69, pp 214-223) **Simulation model for production planning in relation to greenhouse horticulture.** Haakansson, B. (Sveriges Lantbruksuniversitet, Avd. foer traedgaardsekonomi, Alnarp (SE)). 1987. (In Swedish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

A simulation model for production planning in greenhouses was developed at Alnarp. The planning is based on gross margin calculations and information about the need of greenhouse space and labour for each crop. During the planning procedure, a dia-

gram showing the use of greenhouse area is drawn on the screen giving an overview of how the greenhouse space is used. The planner chooses the amount of each crop, and the greenhouse where it shall be grown. Incomes and costs are then calculated as well as fuel consumption and labour requirement. The program also includes a routine for budgeting.

22444 (SBI-Landbrugsbyggeri—69, pp 224-229) **Planning models - operational optimization.** Lippert, T. (Dansk Erhvervsgartnerforening, Copenhagen (DK)). 1987. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

Production planning in a pot plant nursery is very complex. A combination of linear programming and economy is an extremely suitable working instrument, which in one operation results in a production plan with the highest possible gros margin. Should the fuel cost change, it is possible using this model to work out a new optimal production combination very quickly.

22445 (SBI-Landbrugsbyggeri—69, pp 230-234) **Investment evaluation.** Munthe Fog, M. (Statens Jordbruskoekonomiske Institut, Driftsoekonomisk Afdeling, Frederiksberg (DK)). 1987. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

Investigations of the energy consumption in horticultural holdings has shown that the energy consumption in the greenhouses is only a part of the total energy consumption. The residue, the basic energy consumption, is loss during transport of energy from the boiler room to the greenhouses, and heat requirement in growrooms and packingrooms etc. A model for decision making of investments concerning both parts of energy consumption has been developed, based on the net-present-value-method. This method discounts future cash-flow to the moment of investment. With this method the decision model selects the optimum investment from all the investment possibilities.

22446 (SBI-Landbrugsbyggeri—69, pp 246-253) **Using the information you get from the plants' growth to help determine the regulation of greenhouse climate.** Kaukovirta, E. (Helsingfors universitet, Institutionen foer traedgaardsvetenskap Vik, Helsingfors (FI)). 1987. (In Swedish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

Finnish research into the topic internationally named "the speaking plant" was started in 1984. The information gained directly from the plant is a key that theoretically may open up for new ways of climate control in greenhouses. In the research project the plant temperature was chosen as the prime variable to be measured and related to plant growth. The temperature measurements were based on infrared sensing of leaf temperatures. The assimilation of the leaves is another important information. This is calculated on the basis of CO/sub 2/ exchange measurements of selected leaves. In addition, key macro- and micro-climatical factors are measured. The research goal is to produce growth models for short time intervals in order to monitor and control plant growth in greenhouses. As a first step, the conventional research approach using a reference treatment was abandoned. Instead, the main aim is to build the growth models, "communicate" with the plant via a computer with sensors and improve the model as needed. As models are improved, conventional research approach may be used to validate controle strategies based on the models.

22447 (SBI-Landbrugsbyggeri—69, pp 254-259) **Leaf temperature as "speaking plant" measurement - preliminary result.** Pajunen, A.; Maekinen, S. (Helsingfors universitet, Institutionen foer traedgaardsvetenskap, Helsinki (FI)). 1987. (In Swedish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

Control of greenhouse climate is interaction between the control equipment and the conditions in the greenhouse. It is a paradox that the well being of the plant is not part of the control system. One way to approach the well being of the plant is to measure its temperature. Using IR-method will meet the requirements of the "speaking plant"-approach. The potential of leaf temperature as a"speaking plant"-measurement is investigated at the University of Helsinki. Irregular temperature variations and non-uniform temperature distribution, especially under direct radiation has proved to be the central problem in the measurement as well as in the analysis. The effect of air humidity on transpiration and leaf-air temperature difference has been observed by measuring shaded leaves. A drop in the net photosynthesis rate and a rise in leaf temperature in the middle part of a water stressed tomato plant is observed simultaneously with the first visible symptoms of water stress at the top of the plant.

22448 (SBI-Landbrugsbyggeri—69, pp 260-266) **Growth determined climate regulation.** Amsen, M.G.; Statens Planteavlsforsoeg, Sektion for Gartneriteknik, Aarslev; Stroem, J.S. (DK; Statens Byggeforskningsinstitut, Afdelingen for landbrugsbygninger, Hoersholm (DK)). 1987. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

What are the questions that should be asked in order to utilize the potentials of computer control of the greenhouse environment? The traditional control strategy is to maintain the room temperature within prescribed limits. But the air being comfortable does not necessarily mean that the plant is satisfied. Compared with the best analog control equipment the use of computer will not be able to improve room temperature control. But it may improve plant growth. One starting point might be to adjust other factors than those being off the set-point. Temperature low? Increase CO/ sub 2/ concentration. Too little light? Increase room temperature. Instead of restoring factors that are out of balance, we might maintain growth using the factors we are in command of. We cannot avoid climatical disturbances, but we may avoid negative temperature effects on growth rate by compensating with other growth factors than temperature. We assume that existing knowledge can be utilized for growth control when reviewed. But we do also feel pretty sure that new knowledge has to be produced that is tailored to computerized growth control in greenhouses.

22449 (SBI-Landbrugsbyggeri—69, pp 269-272) **Management circles for greenhouse nurseries.** Stroem, J.S.; Amsen, M.G. (Statens Byggeforskningsinstitut, Afdelingen for Landbrugsbygninger, Hoersholm (DK); Statens Planteavlsforsoeg, Sektion for Gartneriteknik, Aarslev (DK)). 1987. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

A conceptual model for the interaction between energy, thermal climate and economy for greenhouse nurseries is presented. The model is based on the principles of the energy management circle and input/output interaction with other management circles.

22450 (SBI-Landbrugsbyggeri—69, pp 273-278) **Computer technology in relation to greenhouse nurseries.** Traberg-Borup, S. (Statens Byggeforskningsinstitut, Afdelingen for landbrugsbygninger, Hoersholm (DK)). 1987. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

The present paper concentrates on possible disciplines, which should be used by growers as integrated tools in the computer technology. These tools could be formed by subjects, such as biometry, production analysis, biotechnical databases, geometrical modelling, non-geometrical modelling and communication. In many ways the use of computer technology will break old habits, but for the growers it will be necessary to become acustomed to the new technology in order to maintain an optimum production.

22451 (SBI-Landbrugsbyggeri—69, pp 279-283) **Plant cultivation of the future.** Skytt Andersen, A. (Havebrugsinstituttet, Landbohoejskolen, Frederiksberg (DK)). 1987. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm. (CONF-8511348—).

From NJF-seminar at Tune Landboskole 1985; Greve, Denmark (11 Nov 1985).

The interest in energy saving measures for greenhouse nurseries disappears with falling energy prices. This is shortsighted, and hopes are that research into the topic will continue. The evolving technologies may be used for other purposes. e.g. thermal heat storage may be used for reduced ventilation and thereby make CO/sub 2/ enrichment attractive even in hot weather. In the future the use of artificial light will develop and computer control applications will multify. The greenhouses will be more adapted to industrial production of plants. Laboratory facilities and growth rooms will be integrated in the nurseries. The state of the plant will present the different alternatives of action and the grower make the important decisions - hopefully.

22452 **(UCRL—100760) Site planning considerations for toxic materials.** Miller, G. (Lawrence Livermore National Lab., CA (USA)). 31 Mar 1989. Contract W-7405-ENG-48. 18p. (CONF-8904128—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009233/JAW.

From Joint Army-Navy-NASA-Air Force safety and environmental protection; San Antonio, TX, USA (3 Apr 1989).

We are developing procedures for controlling emergencies that may arise at sites where toxic materials are used. In our specific example, these materials are semiconductor gases such as phosphine, silane, chlorine, and diborane, but our procedures apply to other operations using toxic materials such as liquid-fueled rocket development and testing. We start by applying or developing Emergency Response Planning Guidelines (ERPGs) for the chemical of interest and we then determine trade offs between gas quantities and other precautions (such as stack heights or flow-limiting orifices) needed to keep ground-level concentrations acceptable during emergencies. We use a version of the widely acknowledged Gaussian-dispersion model (EPIcode) to estimate contaminant levels over 0.1 km from the release point, and we use an adaptation of Wilson's model to estimate concentrations nearer the source. We will discuss these procedures and other considerations (e.g., how we set ERPGs, the relation of ERPGs to other criteria such as Emergency Exposure Limits, and how minimum stack heights are determined) and areas of uncertainty. This paper focuses on planning for emergencies involving toxic materials, routine protection of employees and the public; the normal activities of industrial hygienists and environmental protection personnel are not discussed. 16 refs., 3 figs., 3 tabs.

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REFER ALSO TO CITATION(S) 21646, 21726, 21898, 21900, 21901, 21980, 22350, 22359, 22360, 22849, 23889

22453 **(DOE/CE—0251) DOE state and local assistance programs: Program activities, 1988 report.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC). Dec 1988. 21p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008481/JAW.

Activities of the Office of State and Local Assistance Programs (OSLAP) increasingly focused on a two-pronged conservation effort--that of educating the public about the continued need to use advanced, energy-efficient practices, while encouraging state, local government, and private sector awareness and adoption of CE-developed technologies for conservation and renewable energy. OSLAP grants and the petroleum violation over-charges were proven vehicles in FY 1988 for effecting conservation and renewable resource activities. Following are some of OSLAP's program highlights during FY 1988: (1) energy management, (2) residential and commercial conservation, (3) schools and hospitals, (4) weatherization, (5) support office accomplishments, and (6) states' use of oil overcharge funds.

22454 **(DOE/CE/15210—T5) Method of energy recovery for wastewater treatment: Final technical report.** Chang, Shih-Chih. (Innovative Technology Labs., Kennewick, WA (USA)). [1989]. Contract FG01-85CE15210. 36p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007401/JAW.

The principle of using the energy of falling water to compress air was invented in antiquity and largely forgotten until comparatively recently. It was used by the Romans to supply air to their catalan forges and was not used again until around the turn of the century in this country and Canada as an air compressor in mining, lumbering, canal lock operations and other applications. More recently, the principle was studied extensively as part of an ultra low-head hydropower system. The present application of the principle to subsurface aeration is an innovative method for saving energy and reducing costs of water pollution control. The Hydraulic Compression Aerator (HCA) as this application is called, was invented by Innovative Technology Laboratories. Development of the HAC, which is the subject of this report, was sponsored by a grant (No. CE-FG01-85CE15210) from the US Department of Energy. 7 refs., 10 figs., 1 tab.

22455 **(DOE/CE/64865—T1) Activities and products.** Burns, J.; Zachar, S. (Zachar/Burns Energy Associates, Inc., Phoenix, AZ (USA)). 15 May 1988. Contract FG01-86CE64865. 30p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008586/JAW.

To support the Department of Energy (DOE) Tier One goal of reducing the Department's role as the "spark plug" driving the conservation efforts of the institutions traditionally served by the Institutional Conservation Program the question was asked: "why are some institutions successful at reducing energy costs, and others not, i.e., what are the characteristics of successful institutions?" We undertook to answer that question, and to develop a method of transferring the "answer" to the field. Our work encompassed three primary activities: determining what are the characteristics that enable an institution to successfully reduce its energy consumption; developing a method of communicating that information to ICP's traditional constituency; and testing the methodology.

22456 **(NP—9770294) Investigations on generation and use of a sludge-lime fertilizer.** Boehnke, B.; Weiling, R. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Inst. fuer Siedlungswasserwirtschaft; Umweltbundesamt, Berlin (Germany, F.R.)). Jun 1980. 199p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE89770294/JAW.

Sludge is an important energy and raw material source, which if possible should be utilized in agriculture. Through the addition of unslaked lime a hygienically safe product can be prepared with the help of a suitable treatment process and can be offered in granulated form as a valuable sludge-lime fertilizer. Sludges of different consistencies and origins were investigated. Varying amounts and types of lime were used and the products were tested for easy handling, storage capability and temperature influence on the hygienic conditions. In order to obtain a disseminable substance, a solid matter content of over 60% is necessary. This is achieved through variation of the lime content depending on the solid content of the respective sludge. According to the existing regulations, which fix the minimum CaO content in a lime fertilizer at 30%, a predewatering of the sludge up to 25%-30% of the solid matter content is sufficient. Economic viability is assured, specially in areas where intensive agricultural use of lime fertilizer is necessary. (orig.) With 32 refs., 15 tabs., 27 figs.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 22328, 22453, 23889

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

REFER ALSO TO CITATION(S) 21720, 22406, 22407, 22547

22457 (NAL-TR—965) Study of the PBE cycle 100kN LH_2/LO_2 rocket engine. Kanda, Takeshi; Wakamatsu, Yoshio; Hashimoto, Ryohei; Kanmuri, Akio. (National Aerospace Lab., Chofu, Tokyo (Japan)). Mar 1988. 29p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757173/JAW.

The fundamental studies on the PBE (Partial bleed Expander) cycle LH_2/LO_2 engine which was previously proposed showed good performance for smaller propulsion capacity (i.e. 10kN and under). In this report, the characteristics and performance of the PBE cycle LH_2/LO_2 engine at a medium propulsion capacity (100 kN-thrust class) was discussed. As a result of computer calculations, the PBE cycle which was applied to a partially regeneratively cooled LH_2/LO_2 engine at a 100kN-thrust showed possibility keeping the same engine performance as that of the GG (Gas generator) cycle engine. Among the engines whose thrust chambers were regeneratively cooled, the PBE cycle 100kN engine had the best performance, starting transient simulation analysis showed that the PBE cycle engine can start without trouble. It was not suitable that both the nozzle skirt and the thrust chamber of the PBE cycle 100kN engine be regeneratively cooled. (9 figs, 4 tabs, 16 refs)

22458 (NAL-TR—967) Experimental study of laminar flow control over airfoil with suction through perforated surface at low speed. Ishida, Yoji; Noguchi, Masayoshi. (National Aerospace Lab., Chofu, Tokyo (Japan)). Mar 1988. 16p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757175/JAW.

The characteristics of laminar flow control airfoil with suction through the perforated surface at low speed were studied. The experimental model was a natural laminar flow airfoil, 0.63 m in chord length and 0.55 m in span, and which maximally delayed the boundary layer transition against the transonic speed. It was fitted with a perforated suction surface having 0.7 mm pitch positioned 0.08 mm diameter holes. With 15 m/s of wind speed in the wind tunnel, the starting and finishing points of transition were measured by the surface pitot manometric method. In case without suction, the natural transition occured at the station of $x/c = 0.674$ (where x: chord directed axis and c: chord length) with flow then becoming turbulent downstream. When the 6th suction chamber corresponding to the natural transition point and 7th suction chamber immediately behind it were added with suction of 450 and 220 cc/s, respectively, laminar flow was kept as far as $x/c = 0.913$. And the airfoil profile drag decreased by 18 % against the case without suction. To delay the boundary layer transition, the suction at the natural transition point and downstream behind it is effective. But the suction upstream is not effective. The theory and above experiment coincide with each other. (21 figs, 1 tab, 10 refs)

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 22402, 22402, 22404

22459 (NP—9770285) Construction of turbine components with near-finished contours on the basis of nickel or titanium PM materials using advanced metal cladding and case-free techniques. Composite isostat pressing of PM materials. Final report. Borchert, B.; Kraus, M.; Lackermeier, R.; Track, W. (Motoren- und Turbinen-Union G.m.b.H., Muenchen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1986. 57p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89770285/JAW.

An essential aim of the development of the first period of the order was the design of the engine components, as close as possible to the final contour, by means of powder metallurgy. This work was successfully terminated with the realization of a complex disk of an engine for civil use. Thus, the required knowledge was exemplarily worked out, with which it is possible to produce similar rotation-symmetric components with minimum development-expense and material employment in nickel base alloys. In the final period of the order, the development work concentrated on the realization of components with properties adapted to the local stress. This aim shall be reached by means of the compound process of various materials in different initial states. The tests on the connection of a cast turbine rim - with high creep strength - with a PM hub were successful with regard to technical feasibility as well as attainable properties. (orig./IHOE).

22460 (NP—9770305) Contribution to the experimental determination of the course of injection in a high speed diesel engine. Notz, H.W. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 11 Dec 1986. 159p. (In German). . Order Number DE89770305/JAW.

The aim of a research project explained in detail was to develop a process by which the course of injection can be determined in the operation of a high speed Diesel engine. Calculations of tick-over, part load and full load operation points for all injection systems should be made possible. Starting from the state of technology (differential equations of the pipes and their performance for one-dimensional changeable flow; equations of the part systems according to the volume), there is a report on the execution of the technical measurements. Data on this refer to determining the boundary conditions, measurements and measuring equipment, such as the engine test rig and pump test rig. Determining the course of injection was done by calculating the total injection system (pump, pipe, nozzle, reflection conditions of the pressure waves, damping pressure waves, changeable speed of sound) and by combined measurement-calculation processes and determining the pipe pressure and stroke of needles. Calculations and measurements are compared. (HWJ).

3302 External Combustion Engines

REFER ALSO TO CITATION(S) 22402

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 22264, 22266, 22348, 22402

22461 (CONF-890240—5) Laboratory evaluation of advanced battery technologies for electric vehicle applications. DeLuca, W.H.; Kulaga, J.E.; Hogrefe, R.L.; Tummilo, A.F.; Webster, C.E. (Argonne National Lab., IL (USA)). 1989. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009810/JAW.

From International congress and exposition of the Society of Automotive Engineers, Inc.; Detroit, MI, USA (27 Feb 1989).

During 1988, battery technology evaluations were performed for the Department of Energy and Electric Power Research Institute at the Argonne Analysis and Diagnostic Laboratory. Cells and multicell modules from four developers were examined to determine their performance and life characteristics for electric vehicle propulsion applications. The results provide an interim measure of the progress being made in battery R&D programs, a comparison of battery technologies, and a source of basic data for modeling and continuing R&D. This paper summarizes the performance and life characterizations of twelve single cells and six 3- to 24-cell modules that encompass four technologies (Na/S, Ni/Fe, lead-acid, and Fe/Air). 4 figs., 1 tab.

22462 (CONF-890315—1) Advanced batteries for electric vehicles. Nelson, P.A. (Argonne National Lab., IL (USA)). 1989. Contract W-31109-ENG-38. 19p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009771/JAW.

From 4. international seminar on lithium battery technology and applications; Deerfield Beach, FL, USA (6 Mar 1989).

Over the past twenty years, some of the most difficult problems have been solved in the development of long-lived lithium/sulfide secondary batteries having molten chloride electrolytes. Recent tests of Li-Al/FeS_2 cells have demonstrated 1000 cycles of operation and the practicality of achieving a specific energy of 175 Wh/kg for prismatic cells. Bipolar cells now under study may achieve even higher specific energy. Also, bipolar cells make possible the use of low-cost coated current collectors for the positive electrode instead of the expensive molybdenum current collectors that have been required for prismatic cells. Very compact batteries to power an electric van have been conceptually designed with this approach. These batteries would provide a range for the loaded vehicle of more than 100 miles for a battery weighing 280 kg, only 15% of the loaded vehicle weight (1930 kg). 16 refs., 5 figs., 5 tabs.

22463 **(DOE/CE—0247) Electric and Hybrid Vehicles Program: Twelth annual report to Congress for fiscal year 1988.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Transportation Systems). Feb 1989. 39p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008988/JAW.

This twelfth annual report on the implementation of the Electric and Hybrid Vehicle Research, Development and Demonstration Act of 1976 (Public Law 94-413, as amended by Public Law 95-238, and Public Law 96-185), referred to as the Act, complies with the reporting requirements established in Section 14 of the Act. In addition to informing Congress of the progress and plans of the Department of Energy's Electric and Hybrid Vehicles Program, this report is intended to serve as a communication link between the Department and all of the public and private interests involved in making the program a success. During FY 1988, significant progress was made toward fulfilling the intent of the Congress in the Act. There has been continuing interest shown by both the automobile manufacturing and supply sectors of our economy in electric and hybrid vehicles. The three major domestic automobile manufacturers are all devoting some effort towards electric vehicles. Their participation includes cost-shared contracts with the Department of Energy and the Electric Power Research Institute as well as independently funded activities. Research and development efforts in batteries and propulsion components continue to achieve significant progress in providing industry with technology options that will result in vehicles that will be more economically competitive and more acceptable to the public. 15 figs., 4 tabs.

22464 **(EGG-M—88460) Assessment of EV batteries and application to R&D planning.** Henriksen, G.L.; Patil, P.G.; Ratner, E.Z.; Warde, C.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1989. Contract AC07-76ID01570. 8p. (CONF-890240—2). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009720/JAW.

From International congress and exposition of the Society of Automotive Engineers, Inc.; Detroit, MI, USA (27 Feb 1989).

To guide future EV battery R&D programs, the US Department of Energy (DOE) commissioned a comprehensive assessment of secondary battery technologies. A total of 67 battery developers---from the United States, Canada, Europe, Asia, and Africa---were solicited to submit battery design concepts for an "Improved Dual-Shaft Electric Propulsion" (IDSEP) van. A team of 10 consultants and 7 representatives from DOE laboratories evaluated 42 developer responses and consultant-prepared designs. Using six criteria---five technical/economic criteria and a maturity/technical barriers criterion---the assessment identified 12 most-promising batteries. Employing a generic EV-battery development-system framework, the assessment results are being used to formulate multi-year R&D plans and schedules for the most-promising developmental batteries. 6 refs., 1 fig., 6 tabs.

22465 **Overview of U.S. government programs on electric vehicles.** Brown, P.J.; Kirk, R.S.; Patil, P.G. (Electric and Hybrid Propulsion Div., Office of Transportation Systems U.S. Dept. of Energy, Washington, DC (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889285.

Cognizant of the fuel flexibility inherent in electric vehicles and having just gone through the energy crisis of 1973, Congress passed Public Law 94-413, the electric and Hybrid Vehicle Research, Development and Demostration Act of 1976. A primary purpose of the ACt was to encourage and support the accelerated development of electric and hybrid vehicle technologies. In addition to fuel flexibility for transportation, air pollution concerns and electric utility load leveling have spirited interest in electrical and hybrid vehicles. The congress and the Administration have continued to support effort in this area through the Fiscal Year 1988 appropriation and Fiscal Year 1989 markups to date. This paper gives an overview of the current ongoing development effort supported by the U.S. Government.

3304 Hybrid Systems

REFER ALSO TO CITATION(S) 22266, 22402, 22461, 22462, 22463, 22464

3307 Emission Control

REFER ALSO TO CITATION(S) 21890, 23065

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 21890

22466 **(NEDOJ-P—8743) Survey of development trends of methanol automobiles and methanol fuel in China.** Hashimoto, Tsuyoshi; Sato, Takehiko; Suzuki, Ryo; Toichi, Tsutomu; Kikuchi, Tomoya. (New Energy and Industrial Technology Development Organization, Tokyo (Japan)). May 1988. 158p. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88756492/JAW.

This report was prepared basing upon the results of the field survey in China during the period from January through May 1988. In China, the Seventh Five-Year Program is now being carried out and the established target is to quadruple her national income in a 20 year period from 1981 through 2000. It is planned to secure the supply of energy in the future mainly with coal and from the viewpoints that the demand of fuel for transportation in the future is expected to increase greatly and that she has such feedstock for methanol as coal abundantly, she is very active in the development concerning the introduction of methanol as automobile fuel. In this survey, the basic survey concerning the policy of oil alternate energy including (1) the countermeasure concerning fuel for transportation, (2) the current situation of the research and development of methanol automobiles as one of the oil alternate policies and its appropriate assessment and (3) the current situation and the future prospect of methanol as fuel was conducted and the consolidation of information for the examination of the feasibility of the cooperation between Japan and China in the future was made. (28 figs, 94 tabs)

35 ARMS CONTROL

3501 Policy, Negotiations, And Legislation

22467 **(INIS-XN—153) Notice to exporters on products prohibited from export (nuclear material, equipment and large nuclear units).** (International Atomic Energy Agency, Vienna (Austria)). 12 Aug 1988. 4p. (In French). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706180/JAW.

Published in the Journal Officiel de la Republique francais.

In order to ensure that the policy to avoid the proliferation of nuclear weapons is complied with, the French Administration applies stricter controls over the export of certain sensitive products, materials and equipment. To this effect, lists of such products, materials and equipment are published in the form of Notices to exporters and periodically revised. This Notice repeals and replaces the previous Notice published in the Official Gazette of 21 January

1986. Annex I contains the list of materials whose export is subject to nuclear non-proliferation controls. Annex II lists the equipment whose export is subject to the same controls. Annex III includes the list of large nuclear units for which an application for prior approval of export must be submitted to the Administrations concerned. (NEA).

3502 Proliferation

REFER ALSO TO CITATION(S) 21877

36 MATERIALS

REFER ALSO TO CITATION(S) 21968, 21969, 22295

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 21626, 21626, 21626, 21626, 21664, 21768, 21774, 21774, 21776, 21776, 21828, 21943, 21964, 22025, 22037, 22051, 22061, 22084, 22090, 22095, 22095, 22130, 22134, 22134, 22278, 22408, 22412, 22459, 22675, 22706, 22788, 22837, 23323, 23697, 23836, 23836, 23836, 23836, 23836

22468 **(BNL—42094) Locating pitting sites from propagating surface potential transients.** Isaacs, H.S.; Davenport, A.J.; Rulon, P.J. (Brookhaven National Lab., Upton, NY (USA)). 1989. Contract AC02-76CH00016. 11p. (CONF-890437—7). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006171/JAW.

From Corrosion '89; New Orleans, LA, USA (17 Apr 1989).

The propagation of potential transients along passive metal surfaces has been measured and modeled in order to analyze those transients detected following pit over the exposed surface the location of the pit site can be determined. 8 refs., 10 figs.

22469 **(CEA-CONF—9677) New graphic classification and theory of H effects on the mechanical properties of metal systems.** Fidelle, J.P. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 91 (France)). Sep 1988. 5p. (CONF-8809307—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757178/JAW.

From Congress on metal-hydrogen systems: fundamentals and applications; Stuggart, DE, USA (4 Sep 1988).

A simple use of the theory of sets allows an accurate yet concise classification of hydrogen effects on metals mechanical properties, generally embrittlements and/or corrosions or other effects, mostly noxious or sometimes favorable but limited. Gas bubbles role is more general than reported. Metals affected by (a) dissol-ved (-ing) H or (b) solid hydrides able to be generated by direct hydrogen/solid metals reactions are, like H itself, "A" metals of Mendeleiev's table; "B" metals are not affected, or only under extreme conditions, unless alloyed with A metals.

22470 **(CEA-CONF—9705) Influence of laser surface treatment on properties of Zircaloy-4 cladding.** Darchis, L.; Charissoux, C.; Mardon, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie; Fragema, 69 - Lyon (France)). (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Nov 1988. 10p. (In French). (CONF-8811180—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757182/JAW.

From Meeting of the Societe Francaise d'Energie Nucleaire (SFEN); Paris, France (23 Nov 1988).

A beta phase is obtained on 1/10 of the tube thickness by laser surface quenching of Zircaloy-4 cladding. The treated zone is characterized from the microstructural point of view and differences with conventional treatment on the whole thickness are evidenced. Corrosion resistance in autoclave is improved and irradiation in progress in the IRENE loop with determine the behavior under radiations. Process evolution in a semi-industrial context is evoked.

22471 **(CEA-tr—2300) Zirconium base alloy fabrication process.** Nakajima, J.; Kawada, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Nov 1987. 7p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757187/JAW.

Corrosion resistance of zirconium base alloys is improved by heating above 750/sup 0/C and hot forming at the same time, in particular for fabrication of upper and lower plugs of fuel pins.

22472 **(CONF-881155—52) A first-principles calculation of the resistivity and thermopower in strong-scattering alloys.** Brown, R.H.; Allen, P.B.; Nicholson, D.M.; Butler, W.H. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400;AC02-76CH00016. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008565/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

We investigate the concentration and short-range order dependence of the zero-temperature resistivity and thermopower for substitutionally ordered alloys from a first-principles approach. The alloy disorder is simulated by calculating the electronic structure of a large supercell (typically 200-250 atoms) with periodic boundary conditions. For the strong-scattering alloys we consider, the electron mean-free path is much less than the supercell dimension, causing artificial effects of periodicity to be negligible. In spite of strong scattering, there is no evidence for localized states near E/sub F/. The resistivity and thermopower are averaged over several configurations resulting in statistical error bounds of approximately +- 10%. The concentration-dependent resistivity of substitutional V/sub 1-x/Al/sub x/ alloys agree well with Korringa-Kohn-Rostoker coherent potential approximation (KKR CPA) calculations. This confirms the accuracy of KKR CPA theory. 11 refs., 4 figs.

22473 **(CONF-881155—53) Deformation twinning in ordered intermetallic compounds.** Yoo, M.H.; Fu, C.L.; Lee, J.K. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008748/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

Mechanistic understanding of deformation twinning in ordered superlattice structures is reviewed, and the inter-relationships between twinning and generalized plastic flow or fracture toughness are discussed. While general discussions refer to all the fcc-based and bcc-based cubic and noncubic ordered intermetallic alloys, specific calculations of the energetic and kinetic aspects of deformation twinning are made for TiAl. The importance of the twin-slip conjugate relationship on high temperature mechanical properties is emphasized. Discussion is given of possible effects of macro- and micro-alloying on twinning propensity. 40 refs., 4 figs., 2 tabs.

22474 **(CONF-881155—56) X-ray diffuse scattering study of vacancy and interstitial loops in ion-irradiated copper.** Maeta, H.; Larson, B.C.; Sjoreen, T.P.; Oen, O.S.; Lewis, J.D. (Oak Ridge National Lab., TN (USA)). Mar 1989. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009620/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

Interstitial and vacancy loops in ion-irradiated copper have been studied through the use of x-ray diffuse scattering in the "Asymptotic" scattering region near the (111) reflection. Diffuse scattering measurements were made on copper single crystals irradiated at room temperature with He, O, and Si ions, and the results have been analyzed in terms of size distributions of interstitial and vacancy dislocation loops. The measurements were made in an "off-symmetry" direction (along the Ewald Sphere) using a single angular setting of a linear positive sensitive detector. The He ion-irradiation was found to produce mainly interstitial loops while the O and Si irradiations produced both vacancy and interstitial loops. 10 refs., 5 figs., 1 tab.

22475 **(CONF-8612174—1) Evidence concerning crack-tip constraint and strain-rate effects in fracture-toughness testing.** Merkle, J.G. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008601/JAW.

From Vessel integrity review group meeting; Oak Ridge, TN, USA (2 Dec 1986).

The procedures for measuring the plane strain fracture toughness, K/sub Ic/, of metals were originally developed for relatively high yield strength materials, the toughnesses of which were not affected by stain rate. The application of these procedures to lower yield strength and higher toughness structural and pressure vessel steels have since revealed a perplexing combination of problems involving the effects of geometry, stable crack growth and strain rate on the measured values of toughness. Only the geometric problems were encountered in the development of the procedures for measuring K/sub Ic/. For fracture in the linear elastic range of the load-displacement curve, these problems were overcome by specifying specimen dimensions sufficiently large with respect of the plastic zone size at fracture. However, in the case of structural and pressure vessel steels, it is not always possible to test specimens large enough for fracture to occur prior to general yielding. Therefore, in these cases, the effects of large-scale yielding prior to fracture cannot be avoided, but since they presently have no analytical explanation they are being treated empirically.

22476 **(CONF-8811161—4) The effect of boron on microhardness in Ni_3Al polycrystals.** Qian, X.R.; Chou, Y.T. (Lehigh Univ., Bethlehem, PA (USA)). 1988. Contract FG02-86ER45256. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009124/JAW.

From MRS symposium on high-temperature ordered intermetallic alloys; Boston, MA, USA (28 Nov 1988).

In a recent MRS symposium, the effect of boron on grain boundary hardness (GBH) in Ni_3Al was reported. Addition of 0.2 at. % of boron decreased the GBH in all three sets of alloys tested (24, 25, and 26 at. % Al). The present paper summarizes the study of the effect of boron on hardness within grains. Boron-induced softening was again observed in grain interiors. However, it occurred only in alloys with 24 and 25 at. % Al, but not in the alloy with 26 at. % Al. An explanation for this behavior is presented. 14 refs., 5 figs., 4 tabs.

22477 **(CONF-8811186—1) An acoustic emission investigation of the tensile failure of cathodically charged 304 stainless steel.** Carpenter, S.H.; Xu, W.; Smith, D.R. Jr. (Denver Univ., CO (USA)). 1988. Contract FG02-85ER45182. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008752/JAW.

From 9. international symposium on acoustic emission; Kobe, Japan (1 Nov 1988).

It has been shown that using different heat treatments and cathodic charging a variety of crack modes could be obtained in 304 stainless steel. Using double cantilever beam specimens Smith and Carpenter measured and characterized the AE generated during crack propagation. They found that the type of crack propagation could be identified from the characteristics of the AE waveforms. The purpose of the investigation reported on in this paper was to see if similar results could be obtained during the tensile fracture of 304 stainless steel. Excellent results were obtained. Results will be presented which clearly demonstrate that the type of crack mode in tensile fracture can be determined from careful analysis of the AE waveforms. 11 refs., 8 figs.

22478 **(DOE/CE/90001—6) The joint effect of surface microtopography and near-surface structure on microcontact conditions: [Quarterly progress report, November--December 1988 and January 1989].** McCool, J.I. (SKF Industries, Inc., King of Prussia, PA (USA)). 1989. Contract AC02-87CE90001. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008517/JAW.

Pin-on-disk tests are now complete on 18 of the 27 ceramic Phase I specimens. A total of 45 hardened M50 high alloy steel disks have been fabricated. Three distinct surface finishes, having nominal values of 1, 3, and 10 microinch rms, have been applied to sets of 15 of these specimens. Numerical results taken from a study found in the literature on the analytical determination of the deformation of layered half spaces by an axisymmetric rigid indentor have been recast in the form of correction factors wherewith a microcontact analysis of coated rough surfaces can be performed using simulation. 2 refs., 3 figs.

22479 **(DOE/CE/90001—T1) The joint effect of surface microtopography and near-surface structure on microcontact conditions: Progress report, March--May 1988.** McCool, J.I.; Bunting, B.G. (MRC Bearings, Jamestown, NY (USA)). Nov 1988. Contract AC02-87CE90001. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008568/JAW.

A program has been written to compute flash temperature distribution using the Kuhlmann-Wilsdorf formulas for the interfacial temperature under arbitrary sliding speeds. As such the program can account for the effect of reversing the roles of two dissimilar materials in a sliding contact. The program was applied to scuffing test data on steel disks. The predicted mean flash temperature varied inversely with scuffing load for both the ground and polished specimens used in the scuffing tests. A paper describing the computational methodology of the program and the application to scuffing test has been prepared. Flat tests specimen blanks of three materials, have been finished at NBS and will be tested along with the commercially finished specimens acquired for this program. 1 ref., 1 fig.

22480 **(DOE/ER/45095—T1) Vibrational and optical properties of amorphous metals: Progress report, July 1, 1987--June 30, 1988.** Lannin, J.S. (Pennsylvania State Univ., University Park (USA). Dept. of Physics). Feb 1988. Contract FG02-84ER45095. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009545/JAW.

Substantial progress has been achieved in the three areas of Raman scattering, inelastic neutron scattering and optical studies of amorphous metal alloys. In the Raman area, studies of amorphous disilicides of Ni and W, a-$NiSi_2$ and a-WSi_2, were obtained that provide information on both the dynamics and short range order in the amorphous phase. Measurements of the Raman spectra have been compared to the neutron weighted densities of states of the corresponding crystalline systems. A detailed evaluation of the inelastic neutron spectra of the concentrated Ni alloy of a-Ni/sub .95/Tb/sub .05/ has recently been completed. Optical measurements of the real and imaginary parts of the dielectric function of a-Ni/sub .95/Tb/sub .05/ were also performed during this year using the technique of spectroscopic ellipsometry. Raman scattering measurements were performed on the amorphous state of the counterpart of the high temperature superconductor of crystalline YBa_2Cu_3O/sub x/.

22481 **(DOE/ER/45182—4) Investigation of fracture toughness and fracture mechanisms using acoustic emission measurements: Progress report, 1 March 1988--28 February 1989.** Carpenter, S.H. (Denver Univ., CO (USA). Dept. of Physics). Oct 1988. Contract FG02-85ER45182. 9p. NTIS, PC A02/MF A01 - OSTI; GPO Dep. Order Number DE89008574/JAW.

This report provides a brief discussion and presentation of the progress accomplished on the research program "Investigation of Fracture Toughness and Fracture Mechanisms using Acoustic Emission Measurements" for the time period of 1 March 1988 through 28 February 1989. The report time period is the first year of a new program, hence a good deal of effort has been expended acquiring the proper sample materials and in the design and fabrication of test specimens. To date, materials for two of the basic experiments has been secured, samples have been fabricated, heat treated and limited data obtained. We are in the process of obtaining sample material for the third experiment. While waiting for material and in order to train the new graduate student work was continued on the test material (304 stainless steel) from the previous experiment. An excellent result was obtained which will be discussed in detail in the main body of this report. Work planned for the remainder of the time period covered in this report will also be presented.

22482 (DOE/ER/45214—T4) Twin boundaries, interfaces and modulated structures in martensites: Annual progress report No. 4, July 1, 1988--June 30, 1989. Barsch, G.R. (Pennsylvania State Univ., University Park (USA). Materials Research Lab.). 15 Mar 1989. Contract FG02-85ER45214. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009064/JAW.

A comprehensive theoretical study with concurrent supporting experimental investigations is being carried out on coherent and semicoherent interfaces in ferroelastic martensites, including twin boundaries and twin bands, heterophase parent/product interfaces and inclusions, and transformation precursors. This work is motivated by the need for a new theoretical basis for investigating the martensite nucleation mechanism and for establishing the conditions for nonclassical nucleation. Soliton-like solutions of a dynamic Ginzburg-Landau continuum theory for ferroelastic martensites are being studied in order to determine the strain distribution, strain energy and dynamical behavior for various geometric configurations as a function of the material parameters, temperature and boundary conditions. Model parameters of the theory consist of the second and higher order elastic constants and the harmonic strain gradient coefficients in the parent phase. X-ray measurements of the transformation strain versus temperature, and ultrasonic velocity and attenuation measurements on biaxially stressed crystals in In/sub 1-x/Tl/sub x/ alloys for determining the second and higher order elastic constants in the single domain tetragonal state and for studying the morphology and the dynamic behavior of the martensite interfaces and transformation precursors are in progress. 6 refs.

22483 (DOE/ER/45290—2) Mechanisms of diffusion-controlled brittle fracture: Progress report, April 1, 1988--March 31, 1989. McMahon, C.J. Jr. (Pennsylvania Univ., Philadelphia (USA)). 13 Feb 1989. Contract FG02-87ER45290. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008728/JAW.

During the past year the major accomplishments have been the completion of the first UHV testing chamber and the demonstration of the cracking phenomenon in a Cu-8 wt % Sn alloy. The latter alloy was fabricated in our laboratory and was selected because of reports in the Japanese literature of reduced ductility due to intergranular fracture in such an alloy in the range 300--600{degree}C and because of the well-documented surface-cavity of tin in this alloy system. Tin, of course, is a powerful embrittling element in iron and steel. In confirmation of the hypothesis, the slow brittle fracture phenomenon has been produced in this alloy at temperatures as low as 250{degree}C. 3 refs., 10 figs.

22484 (DOE/ER/45310—17) Grain boundaries: Progress report, June 15, 1988--June 14, 1989. Balluffi, R.W.; Bristowe, P.D. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). Feb 1989. Contract FG02-87ER45310. 12p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008881/JAW.

The present document is a progress report describing the work accomplished during the second year (June 15, 1988-June 14, 1989) of our three-year grant to study grain boundaries which started 15 June 1987. The research that was proposed initially for this period consisted of the following: (1) study of the atomistic structure of grain boundaries by means by combined x-ray diffraction and computer modeling; (2) study of grain boundary phase transitions by electron microscopy and computer modeling. 12 refs.

22485 (DP-MS—88-177) Aqueous impurity effects on stainless steel IGSCC [intergranular stress corrosion cracking]: A central composite matrix analysis. Ondrejcin, R.S.; Caskey, G.R.; Aldred, P.; Clarke, W.L.; Wilson, S.A. (Savannah River Lab., Aiken, SC (USA)). [1988]. Contract AC09-76SR00001. 20p. (CONF-890437—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE88017382/JAW.

From Corrosion '89; New Orleans, LA, USA (17 Apr 1989).

Sixty sensitized Type 304 stainless steel CERT samples were tested in a central composite statistical matrix to determine the effects of temperature, hydrogen peroxide, oxygen, carbon dioxide, sulfate and chloride concentrations and to rank them with respect to aggressiveness. Measurement and control of the variables was in real time. The ranges of these variables were based on the moderator conditions in Savannah River Plant reactors and are similar to conditions during some light-water reactor start-ups. 7 refs., 9 figs., 6 tabs.

22486 (EGG-M—88151) Applications of a digital acoustic-emission data-acquisition workstation. Johnson, J.A.; Carlson, N.M.; Allemeier, R.T. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 8p. (CONF-880760—11). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009648/JAW.

From Review of progress in quantitative nondestructive evaluation; La Jolla, CA, USA (31 Jul 1988).

An eight-channel, data-acquisition system is used to acquire and analyze acoustic-emission [AE] data from aluminum surface-crack specimens. The system is calibrated using known source locations and laser-generated ultrasound to determine the transducer locations by finding the arrival time of the longitudinal wave and then doing a nonlinear, least-squares fit. From these transducer locations, the origin of AE sources can be determined using a similar procedure. Automated methods for determining source location by finding the first signal above noise on each channel and identifying this signal as the longitudinal wave arrival are developed for processing the vast amount of data generated during a typical experiment. The application of these methods to data acquired during tensile testing is discussed. A goal of this research is to sense acoustic events to enable the prediction of conditions for initiation of crack growth. The predictions will be based on models being developed by Parks and McClintock that calculate the effects of specific crack growth conditions. 5 refs., 5 figs., 1 tab.

22487 (GKSS—88/E/54) Mechanized hyperbaric welding by robots. Aust, E.; Santos, J.F. dos; Bohm, K.H.; Hensel, H.D. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Anlagentechnik). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Anlagentechnik). 1988. 21p. (CONF-8804258—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757357/JAW.

From Underwater technology conference (ROV '88 - INTERVENTION '88); Bergen, Norway (17 Apr 1988).

At the GKSS-Forschungszentrum investigations are carried out on mechanized welded test plates produced under working pressure between 10 to 110 bar in breathable TRIMIX-5-atmosphere. The welds are performed by a modified industrial robot, which was adapted in its components to withstand these severe conditions. Variations on the welding parameters were made to maintain a stable arc as well as to provide on indication of the effect of the variables on the mechanical properties of the welded joint. During all tests the robot showed a very good function. Good reliable welds were achieved meeting the requirements according API II04 or BS 4515-1984.

22488 (INIS-BR—1440, pp 63) **Preparation of thin films.** Costa, V.L. da. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22489 (INIS-BR—1440, pp 33) **Study of embrittlement in AISI316 stainless steel implanted with helium.** Goncalves, Z.C.; Abreu, A.S. de; Santos, G.R. dos. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22490 **(INIS-mf—11917) Quantification of the damage from superelastic alternating plastification in austenitic materials and welded joints. Final report.** Maile, K.; Waidele, H. (Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Oct 1986. 193p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88757366/JAW.

Fatigue tests, stress rupture tests, crack growth tests, tensile tests and notched-bar impact tests were carried out on sheet metals and welded joints of sheet metals of the melts LU 9559 (nominal thickness 40 or 100 mm), and of the material X6 Cr Ni 1811. Cracks or states of damage could be determined by metallographic and fractographic investigations, as well as with the technique of colour penetration, the eddy-current process, and the direct current potential method, with the aim of detecting and classifyiung damages due to hyperelastic alternating load deformation.

22491 (INIS-SU—72, pp 25-30) **Hyperconducting aluminium: electrical and thermal properties in 0-100 kOe fields and 4-50 temperature range.** Morgun, V.N.; Chebotaev, N.N. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Thermonuclear synthesis. Scientific-technical collection.

The results of the experimental investigation of the electroresistivity and thermoresistivity of the plasticaly deformed hyperconducting aluminium different purity (on impurities) in temperature range 4 - 50 K and magnetic fields 0 - 100 kOe are described. Deformation was made at room and low temperatures. The obtained data give the opportunity to estimated role of the deformation of the electroconducting elements during the constructing of the magnetic systems, which are used at solution problems of the operating thermonuclear synthesis. 27 refs.; 8 figs.; 3 tabs.

22492 (INIS-SU—72, pp 31-36) **Radiation-induced ageing in structural materials.** Barabash, V.R.; Vinokurov, V.F.; Kozhevnikov, O.A.; Saksaganskij, G.L.; Fabritsiev, S.A.; Fefelov, P.A.; Yaroshevich, V.D. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Thermonuclear synthesis. Scientific-technical collection.

Results of an investigation of the structure and phase constitution of ferritic steels, austenitic steels and 45% Ni alloys after thermal ageing prior neutron irradiation, prior helium ingection and during irradiation are presented. Ageing after preirradiation and particular during irradiation is shown to result in the precipitation of phases differing from the ones at thermal ageing in both morphology and size, density and type. Ageing induced hardening of candidate materials for fusion is discussed. 10 refs.; 3 figs.; 2 tabs.

22493 **(IYaF—88-73) On steel superficial hardening by concentrated electron beam in the air.** Vajsman, A.F.; Vasserman, S.B.; Golkovskij, M.G.; Kedo, V.D.; Salimov, R.A. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1988. 31p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705781/JAW.

Possibilities of steel superficial hardening by a concentrated electron beam are studied. Experiments have been conducted since 1985 using the EhLV-6 accelerator with concentrated emission of the beam into atmosphere. Regimes ensuring the hardening and certain characteristic properties of the hardened layer are described. 13 refs.; 16 figs.; 3 tabs.

22494 **(JAERI-M—88-217) Iodine-SCC behavior of irradiated Zircaloy-2 cladding under changing stress.** Suzuki, Motoe; Kizaki, Minoru; Takada, Fumiki. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Nov 1988. 64p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88757254/JAW.

Iodine-SCC test has been conducted using unirradiated and irradiated (2.3 x 10/sup 19/ n/cm/sup 2/) zircaloy-2 claddings. Specimens have been internally pressurized by Argon gas, filled with Iodine vapor, and heated by direct joule-heating at 350 deg C until failure occurred. Stress loading by the internal pressure have been done by the two methods; monotonous and timevarying loadings. Failure features have been compared with respect to such test conditions as stress loading mode, internal pressure intensity, and artifitial pre-flaw in the cladding inner surface. Observed failure mode contained both pinhole and fracture types. While failure time was not clearly dependent on the difference in loading modes, it was affected by the internal pressure intensity and pre-flaw to some extent. Metallographic and fractographic observations have been carried out on the post-test specimens, finding a large amount of zirconium hydride and brittle fracture surface.

22495 **(JINR-R—14-88-290) On observation of inhomogeneities which relax at a low temperature annealing to the glassy state in amorphous fast quenched alloys.** Bezzabotnov, V.Yu.; Borbej, Sh.; Ostanevich, Yu.M.; Kovneristyj, Yu.K.; Mogutova, T.V.; Nartova, T.T.; Tarasova, O.B.; Smirnov, L.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; AN SSSR, Moscow. Inst. Metallurgii; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1988. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706096/JAW.

Submitted to the Organizing Committee of the International Conference on Physics of Transition Metals, Kiev, May 1988.

Comparatively large (about 100A) neutron-optical inhomogeneities which relax at low temperature annealing to the glassy state were observed in amorphous fast quenched alloys (systems Ti-Zr-Si, Ti-Zr-Ge) by small angle neutron scattering. An anomalous dependence of alloy microhardness on temperature proceeded simultaneously with the relaxation. Various microscopic models and experimentally imposed limitations are discussed. 9 refs.; 4 figs.; 2 tabs.

22496 **(LA-UR—89-381) Cryogenic properties of aluminum alloys and composites.** Hill, M.A.; Rollett, A.D.; Jacobson, L.A.; Borch, N.R.; Gibbs, W.S.; Patterson, R.A.; Carter, D.H. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 15p. (CONF-890130—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007747/JAW.

From 13. annual conference on composites and advanced ceramics; Cocoa Beach, FL, USA (15 Jan 1989).

Several aluminum-based materials have been evaluated for possible application at cryogenic temperatures. These included the Al-Li alloy 2090, a high purity mechanically alloyed Al, SiC whisker reinforced Al 2124, and SiC particulate reinforced Al 6061. Mechanical properties, thermal properties and electrical properties were measured for these materials. Their performance in a radio frequency cavity was also determined. 4 refs., 6 figs.

22497 **(LBL—26580) Site occupancy/valence measurements using channelling and related effects in microanalysis.** Krishnan, K.M. (Lawrence Berkeley Lab., CA (USA)). Dec 1988. Contract AC03-76SF00098. 16p. (CONF-8811176—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007658/JAW.

From Magnetic materials workshop; Santa Rosa, CA, USA (14 Nov 1988).

The current status of a novel crystallographic technique to determine specific-site occupations of elemental additions in crystalline materials, using the channelling or Borrman effect in electron diffraction is discussed. This technique is based on the effect of incident beam orientations on the intensities of either the characteristic x-ray emissions or the characteristic electron energy-loss edges. In general, this technique is in good agreement with other well established methods such as x-ray and neutron diffraction but has superior spatial resolution. It involves no adjustable parameters, external standards or special specimen preparations; can distinguish neighbors in the periodic table; is very accurate and is applicable to trace elemental concentrations. In the EELS formulation, the technique can also provide specific site valence information. Finally, the applicability to the study of site occupancies in magnetic materials

(spinels, $Sm_2(Co,TM)_{17}$ alloys, $(Y,RE)_3Fe_5O_{12}$ epitaxial films, etc.) has been well demonstrated. 23 refs., 3 figs.

22498 **(NP—9770309) Contact corrosion of different metal pairs in sea water.** Hargarter, E. (Fachhochschule Hamburg (Germany, F.R.). Inst. fuer Werkstoffkunde; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 15 Mar 1988. 115p. (In German). NTIS (US Sales Only), PC A06. Order Number DE89770309/JAW.

The corrosion behaviour of various materials at the North and Baltic Seas in cases of free and contact corrosion was studied. The materials X3CrNiMoN17 13 5, CuNi10Fe, CuZn20Al, grade A shipbuilding steel, and AlMg4, 5Mn were tested for one or two years at Helgoland and at the Kiel Fiord. Free corrosion potential in cases of free corrosion, the potential of short-circuit materials, element flow, rate of mass loss and the manifestations of corrosion were determined. (orig./MM) With 3 refs., 21 tabs., 31 figs.

22499 **(NUREG/CR—5143) Application of the J-integral and the modified J-integral to cases of large crack extension.** Joyce, J.A.; Davis, D.A.; Hackett, E.M.; Hays, R.A. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Feb 1989. 43p. NTIS, PC A03/MF A01 - GPO - OSTI. Order Number TI89008778/JAW.

The J-integral is widely accepted as a measure of elastic-plastic fracture toughness of engineering alloys. Specimen size and geometry dependence were first noted in fracture toughness measurements using the ASTM-E813 standard calculation of the deformation J-integral (J/sub d/) in 1983. The modified J-integral (J/sub m/) was introduced to attempt to minimize or eliminate size and geometry dependence when crack growth was appreciable. Since J/sub m/ was introduced, questions have arisen regarding the proper parameter to describe the response of a flawed body to loading. The objective of this research task is to investigate the crack growth and specimen J capacity limitations of J/sub d/ and to verify the accuracy and specimen independence of the current J/sub m/ formulation. J-R curve tests have been conducted on 1/2T, 1T, and 2T compact tension specimens of materials having critical fracture toughness values ranging from J/sub Ic/ = 800 in.-lb/in.^{2} to J/sub Ic/ = 2600 in.-lb/in.^{2}. These materials include an ASTM-A710 steel, an A106 steel, a 3% Nickel alloy, and two A533B steels. These tests were conducted according to ASTM E1152-87 with the exception that the specimen loading was continued until large crack extensions were present, in many cases exceeding 50% of the initial uncracked ligament. All specimen data was then analyzed using the equations of E1152-87 for the standard deformation J-integral (J/sub d/) resistance curve. Additional analysis was conducted as well in terms of the modified J integral (J/sub m/) using equations proposed by Ernst and Landes. 10 refs., 16 figs., 9 tabs.

22500 **(ORNL/Sub—85-27488/03) Effects of thermo-mechanical pretreatments on the flow strength of a copper modified, stabilized 316 stainless steel.** Black, R.D.; Carolan, R.A.; Li, Che-Yu; Swindeman, R.W.; Maziasz, P.J. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). Jan 1989. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008631/JAW.

The effects of thermo-mechanical pretreatments on the elevated temperature (650-700{degree}C) flow properties of a copper modified and stabilized 316 austenitic stainless steel have been investigated. The flow properties were measured by using the load relaxation test. The pretreatment conditions included variations in (a) solution treatment temperature, (b) level of cold work prior to aging, and (c) stabilization aging temperature and duration. It was found that the flow strength of this material is strongly influenced by the pretreatment. The observed changes in flow strength are interpreted as to reflect changes in sizes and the distribution of MC-type carbide precipitates. 13 refs., 8 figs., 3 tabs.

22501 **(PNL-SA—15885) In-plant demonstration of high-temperature EMAT system on continuous caster strand.** Boyd, D.M.; Droney, B.D.; Sperline, P.D.; Jackson, J.F.; Cook, J.R. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 8p. (CONF-8808123—3). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008244/JAW.

From Conference on review of progress in quantitative NDE; La Jolla, CA, USA (1 Aug 1988).

The Pacific Northwest Laboratory (PNL) has been working with the Office of Industrial Programs of DOE and the American Iron and Steel Institute (AISI) since 1983 to develop a sensor that can determine the internal temperature of hot steel bodies. Research projects utilizing the relationship between acoustic velocity and temperature have been the primary technique investigated. The techniques most recently used have been laser-generated stress waves and EMAT systems. Development of an ultrasonic sensor that can measure the acoustic velocity at high temperatures has been the major effort over the past few years. The internal temperature of steel bodies can be determined by measuring the time-of-flight through a known distance to calculate the velocity, and from the relationship between temperature and velocity, the average internal temperature can be determined. A non contact sensor system for measuring the time-of-flight of longitudinal acoustic waves of hot steel objects has been developed. Working with Magnasonics, Inc., the high-temperature capabilities of the pulsed EMAT receiver and EM pulser were developed. The sensors were laboratory tested on hot steel surfaces up to 2300{degree}F. This paper will review the high-temperature EM pulser/pulsed EMAT receiver equipment and the results of the in-plant test performed at the continuous caster at the Baltimore Specialty Steel Corporation, Baltimore, Maryland. 7 refs., 8 figs.

22502 **(PNL-SA—16273) Environment-induced crack growth processes in nickel-base alloys.** Jones, R.H.; Bruemmer, S.M. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 95p. (CONF-8810330—1). NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008253/JAW.

From International conference on environment-induced crack growth of metals; Kohler, WI, USA (5 Oct 1988).

Ni-base alloys exhibit excellent corrosion resistance and are used extensively in corrosive applications, although environment-induced crack growth has occurred in several applications. Environment- induced crack growth in Ni-base alloys occurs in a number of environments, including water, acidic and basic solutions, and gaseous H. Factors controlling environment-induced crack growth are similar to those in other materials, namely, (1) microstructure/microchemistry, (2) environment, and (3) stress. The critical factors controlling stress corrosion cracking of Ni-base alloys are generally known, but many of the details are not. In some cases, quantitative information is lacking with details limited to knowledge about general susceptibility. The crack growth mode is generally intergranular for aqueous environments and H gas environments. A key difference between environment-induced crack growth in FeCrNi alloys and Ni-base alloys is the susceptibility to cracking in H environments in Ni-base alloys, while FeCrNi alloys exhibit cracking in hydrogen environments only under extreme conditions. This paper presents a comprehensive review of the literature on environment-induced crack growth of Ni-base alloys, and covers both phenomenological observation and mechanistic interpretation. 202 refs., 30 figs.

22503 **(RFP—4188) Beryllium electrorefining.** Mitchell, D.L.; Nieweg, R.G.; Ledford, J.A.; Richen, M.J.; Burton, D.A.; Harder, R.V.; Watson, L.E.; Thomas, R.L. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 30 Jan 1989. Contract AC04-76DP03533. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008998/JAW.

Beryllium scrap was purified by electrorefining in a ternary salt bath containing potassium, lithium, and beryllium chloride salts. The beryllium flake produced had a purity greater than 99.95% and was produced at a direct operating cost of slightly less than $500 per pound, not including capital equipment depreciation. 2 refs., 13 figs., 1 tab.

22504 **(UCRL—98739) Ductility enhancement in unreacted internal-Sn Nb_3Sn through low-temperature anneals.** Strum, M.J.; Summers, L.T.; Miller, J.R. (Lawrence Livermore National Lab., CA (USA)). 19 Aug 1988. Contract W-7405-ENG-48. 18p. (CONF-880812—44). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009125/JAW.

From Applied superconductivity conference; San Francisco, CA, USA (21 Aug 1988).

A lack of tensile ductility in as-drawn superconducting wires at room temperature can lead to damage during magnet fabrication steps such as cabling and coil winding. The tensile ductility of 0.42 mm internal-Sn Nb_3Sn conductor in the as-drawn unreacted condition is limited to less than 3 percent at room temperature. Through low-temperature annealing treatments at 200{degree}C the ductility can be substantially enhanced increasing to as high as 10% after 24 hr at 200{degree}C. This effect is attributed to softening which reduces yield strengths up to 50% while maintaining 90% of the tensile strength. Fracture surfaces of annealed wires reveal increased adhesion between the Sn cores and the surrounding Cu as well as an increase in ductile void coalescence as the failure mechanism within the Cu. Preliminary results on the pre-reaction strain sensitivity of reacted wire critical currents confirm the increased strain tolerance in annealed wires. 6 figs., 1 tab.

22505 **(UCRL—100134) Effects of grain size and strain rate on the mechanical response of copper.** Lassila, D.H. (Lawrence Livermore National Lab., CA (USA)). 1989. Contract W-7405-ENG-48. 7p. (CONF-890324—5). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008811/JAW.

From 4. international conference on mechanical properties of materials at high rates of strain; Oxford, UK (20 Mar 1989).

The effects of grain size and strain rate on the flow stress of copper were studied at room temperature. The Hall-Petch relationship was used to analyze the test results. Results of the study suggest that the strengthening effects of grain boundaries in copper are independent of strain rate over the range of strain rates 10/sup {minus}3/ s/sup {minus}1/ to 5 {times} 10^3 s/sup {minus}1/. 6 refs., 5 figs.

22506 **Strength of Terfenol-D.** Peterson, D.T.; Verhoeven, J.D.; McMasters, O.D.; Spitzig, W.A. (Ames Laboratory and Department of Materials Science and Engineering, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics;* **65**: No. 9, 3712-3713(1 May 1989).

The strength of the magnetostrictive material, Terfenol-D, Tb/sub 0.27/Dy/sub 0.73/Fe/sub 2.0/, has been evaluated by measuring the modulus of rupture as a function of the Fe stoichiometry of the compound. It is shown that the strength improves markedly as the Fe concentration decreases from the stoichiometric value of 2.0 in the compound. The increased strength results from the increasing volume fraction of the rare-earth metal phase produced in the Terfenol-D matrix by the solidification process at lower Fe concentrations.

22507 **Effect of magnetic field on the heat capacity of Ni_3Al alloys.** Dhar, S.K.; Gschneidner K.A. Jr. (Ames Laboratory and Department of Materials Science and Engineering, Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 11, 7453-7460(15 Apr 1989).

The heat capacity C of three alloys of nominal composition Ni/sub 74/Al/sub 26/, Ni/sub 74.25/Al/sub 25.75/, and Ni/sub 74.5/Al/sub 25.5/ (hereafter, alloys I, II, and III, respectively) has been measured in zero and applied fields of 2.5, 5.3, 7.5, and 9.8 T in the range 1.5--20 K. The zero-field C/T-versus-T^2 plots show a mild upturn in all three alloys at temperatures below {similar←to}10 K. No discernible effect on heat capacity is observed in the 2.5-T field for alloys I and II, and only at higher fields does the upturn get suppressed. In the maximum applied field of 9.8 T, the C/T-versus-T^2 plots are linear. For alloy III (magnetization measurements at 4.2 K show this material to be magnetically ordered), the upturn is completely removed in the 2.5-T field and the heat capacity decreases progressively in increasing applied fields at all temperatures. The origin of the upturn in C/T is discussed as arising from either spin fluctuations or magnetic clusters. While the zero-field data can be interpreted using either of the two models, the data obtained in applied fields strongly suggest that the upturn in C/T plots is caused by spin fluctuations and that spin fluctuations in these materials are depressed in applied magnetic fields.

22508 **Impurity effects on metallic cohesion: Lithium-row atoms in nickel clusters.** Painter, G.S.; Averill, F.W. (Metals and Ceramics Division, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 11, 7522-7535(15 Apr 1989).

We present results from a theoretical study of the localized bonding in atomic clusters consisting of octahedral nickel hosts and interstitial atoms from the lithium row of the Periodic Table. Trends in impurity binding energies and the effects of impurities on the elastic properties of the host are established by comparison of total energies and interatomic forces of the doped clusters with results for the bare host. Properties of the host cluster are strongly dependent upon impurity atom type. An orbital analysis identifies the microchemical mechanisms through which the elastic properties of the host respond to changes in impurity-host bond character, as we progress from strongly electropositive lithium to strongly electronegative fluorine. The tendency of Li and F to form ionic bonds destabilizes and weakens the Ni host cluster. A bonding mode which is predominantly covalent characterizes the remainder of the first-row series. A nonuniform variation of impurity-induced strain and elastic properties of the host is found, with midrow atoms B, C, and N effecting an appreciable strengthening of the host. Trends in the stability and strengthening character of the midrow series of atoms is a result of competing atom size and covalency effects. There is good qualitative correspondence between the trends and relative effects of different impurities in this study and the observed effects of first-row impurities on the cohesive properties of metallic host interfaces. This relationship suggests the microchemical properties of the cluster model may serve to identify atomic-level factors important to understanding macroscopic impurity effects in grain-boundary segregation.

22509 **Observation of the effect of refraction on x rays diffracted in a grazing-incidence asymmetric Bragg geometry.** Toney, M.F.; Brennan, S. (IBM Research Division, IBM Almaden Research Center, San Jose, California 95120-6099). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 11, 7963-7966(15 Apr 1989).

The positions of x-ray diffraction peaks from a polycrystalline iron oxide thin film have been measured in a grazing-incidence, asymmetric Bragg geometry for incidence angles between 0.09° and 1.04°. The peak positions are shifted from the Bragg angles 2θ/sub B/ due to refraction of the incident x rays as they penetrate the air-solid interface. The shifts are quantitatively consistent with those obtained by applying Fresnel boundary conditions for reflection and refraction of a plane electromagnetic wave at an interface between air and a uniform, absorbing dielectric and they provide confidence in the validity of the Fresnel boundary conditions in the x-ray regime.

22510 **Reply to "Investigation with low-energy electron diffraction of the adsorbate-induced metal relaxations in the Cu(100)-(2 x 2)-S surface structure".** Shirley, D.A.; Terminello, L.J.; Bahr, C.C. (Department of Chemistry, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 11, 8003-8004(15 Apr 1989).

We have compared the structures of p(2 x 2)S/Cu(001) determined by angle-resolved photoemission extended fine structure (ARPEFS) and low-energy electron diffraction (LEED). Several questions are raised regarding the treatment of the inner potential in standard LEED analysis. The need for future experiments that permit a detailed comparison between the two techniques is addressed.

22511 Surface-plasmon-induced desorption by the attenuated-total-reflection method. Lee, I.; Parks J.E. II; Callcott, T.A.; Arakawa, E.T. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6123). *Physical Review [Section] B: Condensed Matter;* **39**: No. 11, 8012-8014(15 Apr 1989).

Surface plasmons excited by a Nd:YAG (YAG, yttrium aluminum garnet) laser in an attenuated-total-reflection (ATR) geometry were used to desorb Al atoms from smooth Al films. The ejected Al atoms were ionized by a pulse-excimer laser and measured by time-of-flight mass spectroscopy. The desorption rate exhibits a sharp maximum at the surface-plasmon resonance angle. The experiment demonstrates that surface-plasmon-induced desorption can be accomplished on smooth surfaces. Since ATR excitation allows the use of a wide range of wavelengths, this method will be useful in the study of electronic desorption processes.

22512 Quasiparticle excitation spectrum for nearly-free-electron metals. Northrup, J.E.; Hybertsen, M.S.; Louie, S.G. (Xerox Corporation, Palo Alto Research Center, 3333 Coyote Hill Road, Palo Alto, California 94304). *Physical Review [Section] B: Condensed Matter;* **39**: No. 12, 8198-8208(15 Apr 1989).

The quasiparticle excitation spectrum is calculated for the nearly-free-electron metals Li, Na, and Al by evaluation of the electron self-energy operator within the GW approximation and a generalized plasmon-pole model. The calculated quasiparticle energies for Na and Al are in excellent agreement with angle-resolved photoemission experiments. For Na in particular, the occupied-band width is significantly narrower than the free-electron value, as found in experiment. Inclusion of exchange and correlation effects in the dielectric matrix is shown to decrease the bandwidth relative to the random-phase-approximation result by a significant amount. Local-field effects, reflected in the off-diagonal elements of the dielectric matrix, are found to have little effect on the quasiparticle band structure of these simple metals.

22513 Electronic structure of the Ag/Si interface: Angle-resolved, energy-dependent, photoemission study. Ardehali, M.; Mahowald, P.H.; Lindau, I. (Stanford Electronics Laboratories, University of Stanford, Stanford, California 94305). *Physical Review [Section] B: Condensed Matter;* **39**: No. 12, 8107-8114(15 Apr 1989).

The photoionization cross section (σ) and the photoelectron asymmetry parameter (β) for the Ag/Si interface [prepared by depositing 0.3 ML of Ag atoms onto a Si(111)7 x 7 substrate at room temperature] in the photon-energy range $h\nu$ = 70--200 eV are compared with the atomic results. Near the Cooper minimum, the $h\nu$ dependence of σ and β from the Ag/Si interface are very close to the experimental values for atomic Ag and to the theoretical predictions in the relativistic random-phase approximation (RRPA) for atomic Pd. This set of experimental data strongly suggests that Ag atoms on the surface of Si do not nucleate into clusters sufficiently large to exhibit valence-band characteristics of bulk Ag and that the Ag/Si system is representative of nonreactive Schottky-barrier formation.

22514 Writing nanometer-scale symbols in gold using the scanning tunneling microscope. Li, Y.Z.; Vazquez, L.; Piner, R.; Andres, R.P.; Reifenberger, R. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). *Applied Physics Letters;* **54**: No. 15, 1424-1426(10 Apr 1989).

The conditions required to electroetch nanometer-sized craters in flat gold substrates with a scanning tunneling microscope operating in air are identified. Reproducible nanometer-scale modifications of the substrate are possible. Letters and complex symbols with linewidths as small as 2 nm have been written. Experiments show that a good tunneling tip is not destroyed by the writing process.

22515 X-ray resonance exchange scattering in UAs. Isaacs, E.D.; McWhan, D.B.; Peters, C.; Ice, G.E.; Siddons, D.P.; Hastings, J.B.; Vettier, C.; Vogt, O. (AT&T Bell Laboratories, 600 Mountain Avenue, Murray Hill, New Jersey 07974). *Physical Review Letters;* **62**: No. 14, 1671-1674(3 Apr 1989).

Resonant enhancement of the magnetic x-ray scattering cross section in UAs has been investigated by tuning the incident x-ray energy through the uranium M/sub IV/ and M/sub V/ absorption edges. At the M/sub IV/ edge the intensity for the (0,0),(5/2) magnetic reflection is enhanced by 10^7 relative to the nonresonant component far above the edge, and is a remarkable 1% of the intensity of the (0,0,2) charge peak. At the M/sub V/ edge the enhancement is 10^5. The dramatic enhancement at M edges has been predicted by Hannon et al., and arises from strong electric multipole transitions between atomic core states and the exchange-split Fermi edge states.

22516 Cooper-pair mass. Cabrera, B.; Peskin, M.E. (Department of Physics, Stanford University, Stanford, California 94305). *Physical Review [Section] B: Condensed Matter;* **39**: No. 10, 6425-6430(1 Apr 1989).

The Cooper-pair mass m/sup */ is defined by use of the gauge-invariant momentum, p/sup */ = m/sup */v = [(h/2π)delphi- (e/sup *//c)A], where phi is the phase of the macroscopically occupied wave function of Cooper pairs of charge e/sup */ (twice the electron charge), A is the total magnetic vector potential, and we have taken the limit of $v << c$. We point out that for a general class of experiments in which the superconductor is in steady-state motion with respect to the laboratory (including uniform rotation), the physically observable Cooper-pair mass m' is measurable, where m' = m/sup */+e/sup */<Phi>/c^2 and <Phi> is the expectation value of the total microscopic electrostatic potential in the bulk metal averaged over the single-electron states that contribute to the superconducting pair wave function. To lowest order m' = m/sup */ = 2m/sub e/, and to first order m/sup */c^2 = μ/sup */-e/sup */<Phi> and m'c^2 = μ/sup */, where μ/sup */ is the electrochemical potential (including the rest mass 2m/sub e/c^2 and the work function W). For niobium the intrinsic mass is m/sup *//2m/sub e/$\cong$1.000 18, and the observable mass for experiments is m'/2m/sub e/$\cong$0.999 992.

22517 Thickness and polarization dependence of the magnetooptic signal from ultrathin ferromagnetic films. Moog, E.R.; Liu, C.; Bader, S.D.; Zak, J. (Materials Science Division, Building 223, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **39**: No. 10, 6949-6956(1 Apr 1989).

Longitudinal Kerr-effect measurements using both s- and p-polarized light are presented as a function of thickness for bcc Fe films grown epitaxially on Au(100) in ultrahigh vacuum (UHV). The motivation is to explore the origins of the magnetooptic response at Fe thicknesses comparable to the depth penetration of light. Special efforts were taken to optically compensate for the birefringence of the UHV window. The compensated measurements yield the magnitude of the complex rotation phi/sub m/ = (phi'^{2}+phi''^{2})/sup 1/2/, where phi' and phi'' are the real magnetooptic rotation and the ellipticity, respectively. The results show linear initial increase of phi/sub m/ with thickness (up to the optical penetration depth) followed by a shallow peak and leveling off to a saturation value of the thick-film Kerr rotation. A review of the relevant theory includes the Faraday and Kerr contributions to the magnetooptic response. The Faraday contribution arises from metallic reflection from the substrate and passage back through the iron overlayer. We argue that the Faraday effect dominates the response in the ultrathin limit, while the Kerr effect controls the thick-film regime.

22518 Solitons in one-dimensional antiferromagnetic chains. Pires, A.S.T.; Talim, S.L.; Costa, B.V. (Universidade Federal de Minas Gerais, Departamento de Fisica, CP 702, Belo Horizonte, Minas Gerais, 30161, Brazil). *Physical Review [Section] B: Condensed Matter;* **39**: No. 10, 7149-7156(1 Apr 1989).

We study the quantum-statistical mechanics, at low temperatures, of a one-dimensional antiferromagnetic Heisenberg model with two anisotropies. In the weak-coupling limit we determine the temperature dependences of the soliton energy and the soliton density. We have found that the leading correction to the sine-Gordon (SG) expression for the soliton density and the quantum soliton energy comes from the out-of-plane magnon mode, not present in

the pure SG model. We also show that when an external magnetic field is applied, the chain supports a new type of kink, where the sublattices rotate in opposite directions.

22519 **Magnetic pairing in a lattice of Kondo ions: Application to UPt_3.** Norman, M.R. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **39**: No. 10, 7305-7308(1 Apr 1989).

Recently, several groups have calculated possible superconducting solutions for UPt_3 from magnetic fluctuation pairing, by utilizing the band-structure Fermi surface and experimental dynamic susceptibility as input. The resulting solutions do not have proper periodicity in reciprocal-lattice space, though. In this paper, a more fundamental derivation of the pairing interaction is given by treating a lattice of interacting Kondo ions. Proper inclusion of umklapp processes leads to odd-parity solutions for UPt_3, with order parameters of A_1/sub u/ or E_1/sub u/ symmetry preferred.

22520 **Lattice expansions and contractions in metallic superlattices.** Huberman, M.L.; Grimsditch, M. (Department of Physics, Michigan Technological University, Houghton, Michigan 49931). *Physical Review Letters;* **62**: No. 12, 1403-1406(20 Mar 1989).

An electronically driven lattice deformation which explains qualitatively the supermodulus effect in metallic superlattices is derived. It is shown in the Thomas-Fermi approximation that the total energy of a metallic superlattice is lowered by uniform deformations of the constituent materials. The theory gives the correct order of magnitude for changes in lattice constants, explains why the supermodulus effect is not observed in systems in which at least one constituent is nonmetallic, and predicts the absence of an effect when the bulk Fermi energies of the constituent metals are equal.

22521 **Specific heat of UPt_3: Evidence for unconventional superconductivity.** Fisher, R.A.; Kim, S.; Woodfield, B.F.; Phillips, N.E.; Taillefer, L.; Hasselbach, K.; Flouquet, J.; Giorgi, A.L.; Smith, J.L. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* **62**: No. 12, 1411-1414(20 Mar 1989).

The specific heats of two samples of UPt_3 have been measured in the vicinity of the transition to the superconducting state. In both cases the specific-heat anomalies are sharper than any previously observed, and two maxima are clearly resolved. The results are interpreted as evidence of a splitting of the transition and unconventional pairing. A model that is consistent with the known sample dependence of the superconducting-state specific heat is used to derive "intrinsic" values of the related parameters.

22522 **Photoemission study of the growth and modification of the Al/Ta(110) interface.** Di Marzio, D.; Ruckman, M.W.; Qiu, S.L.; Jiang, L.; Chen, J.; Strongin, M. (Department of Applied Science, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **39**: No. 9, 5591-5598(15 Mar 1989).

The Al/Ta(110) interface is studied as a function of Al coverage and temperature ($300<T<1400$ K) using photoemission. Valence-band and core-level data suggest that little or no atomic intermixing occurs at room temperature. An electronic state related to the hybridization of Ta 5d and Al 3sp states at the interface is seen at -1.3 eV binding energy. At about 4.6-monolayer-Al coverage, this interface state shifts $\approx$0.7 eV to higher binding energy. A change in the rate of attenuation of the Ta 4f core-level intensity at this Al coverage suggests that the Al overlayer grows in a different mode at higher coverage. Heating to 1010 K results in a reacted overlayer at temperatures consistent with the formation of $TaAl_3$, and a careful examination of the photoemission data indicates that an aluminum-rich surface compound is formed. Further interdiffusion to form Ta-rich surface compounds occurs at higher temperatures.

22523 **Phase stabilities of the Co_3Ti and Ni_3V alloys.** Pei, S.; Massalski, T.B.; Temmerman, W.M.; Sterne, P.A.; Stocks, G.M. (Department of Physics and Department of Metallurgical Engineering Materials Science, Carnegie Mellon University, Pittsburgh, Pennsylvania 15213-3890). *Physical Review [Section] B: Condensed Matter;* **39**: No. 9, 5767-5770(15 Mar 1989).

A linear muffin-tin orbitals (LMTO) total-energy calculation has been carried out on the ordered Co_3Ti and Ni_3V compounds in order to evaluate the relative stability of the $L1_2$ and D0/sub 22/ crystal structures in the A_3B-type transition metal alloys. The correct structure was obtained for both the Co_3Ti (which occurs as the $L1_2$) and the Ni_3V (which occurs as the D0/sub 22/). The calculated structural preferences were further analyzed in terms of the density of states, which indicates that the D0/sub 22/ structure tends to exist when the concentration of valence electrons per atom exceeds 8.65.

22524 **Dephasing effects in a two-dimensional magnetic-breakdown linked-orbit network: Magnesium.** Freericks, J.K.; Falicov, L.M. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **39**: No. 9, 5678-5683(15 Mar 1989).

The galvanomagnetic properties of a magnetic-breakdown linked-orbit network with two-dimensional topology are calculated for the case of a stochastic distribution of defects in the network. The results show excellent agreement with experiments on magnesium and illustrate the transition between a smoothly varying magnetoresistivity (semiclassical regime) and an oscillatory magnetoresistivity (quantum regime).

22525 **Self-consistent calculation of the surface electronic structure of the (1 x 2) reconstructed Au(110) surface.** Xu, C.H.; Ho, K.M.; Bohnen, K.P. (Ames Laboratory--U.S. Department of Energy and Department of Physics, Iowa State University of Science and Technology, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **39**: No. 9, 5599-5604(15 Mar 1989).

Surface bands and the projected bulk band structures along the Gamma-bar--X-bar--S-bar'--Y-bar'--Gamma-bar lines in the two-dimensional Brillouin zone for the (1 x 2) Au(110) reconstructed surface are obtained using self-consistent first-principles calculations. Our results agree well with the inverse-photoemission data reported by Bartynski and Gustafsson.

22526 **Vibrational properties of epitaxial films on metals. I. fcc Cu on the Ni(001) surface.** Tong, S.Y.; Chen, Y.; Yao, J.M.; Wu, Z.Q. (Department of Physics and Laboratory for Surface Studies, University of Wisconsin(enMilwaukee, Milwaukee, Wisconsin 53201). *Physical Review [Section] B: Condensed Matter;* **39**: No. 9, 5611-5616(15 Mar 1989).

The general vibrational properties of epitaxially grown fcc Cu films on Ni(001) have been studied using a central-force lattice-dynamical slab model. The theoretical results predicted the emergence of new film modes as the overlayer film's thickness increases. Calculated phonon dispersion curves and spectral densities are presented and the regions of different localizations for the phonon modes in the two-dimensional projected phonon band have been identified.

22527 **Electronic structure, cohesive, and magnetic properties of the actinide-iridium Laves phases.** Eriksson, O.; Johansson, B.; Brooks, M.S.S.; Skriver, H.L. (Condensed Matter Theory Group, Department of Physics, University of Uppsala, Box 530, S-75121 Uppsala, Sweden). *Physical Review [Section] B: Condensed Matter;* **39**: No. 9, 5647-5654(15 Mar 1989).

The electronic structure of the isostructural AIr_2 systems (A = Th, Pa, U, Np, Pu, and Am) has been obtained by means of the scalar relativistic and fully relativistic linear muffin-tin orbital techniques. Ground-state properties such as lattice constants and onset of magnetic order have been calculated and compared with measured data. The hybridization between the actinide 5f and the ligand 5d states and the direct 5f wave-function overlap are found to be of comparable importance for the bandwidth of the itinerant 5f states.

The anomalous paramagnetism of $PuIr_2$ can be explained only by a fully relativistic treatment.

22528 **Optical properties of Mo.** Kim, B.; Harmon, B.N.; Lynch, D.W. (Department of Physics and Ames Laboratory, U.S. Department of Energy, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **39**: No. 9, 5754-5757(15 Mar 1989).

The interband optical conductivity of Mo was calculated using a self-consistent relativistic band structure. Including electric dipole matrix elements, the results are in excellent quantitative agreement with experiment in the 1--6-eV region. The use of nonrelativistic bands and the neglect of the dipole matrix elements each lead to poorer agreement with experiment. The major relativistic effect is the lowering of the s-like bands, not the spin-orbit splitting. k-space searches identified the regions of the Brillouin zone contributing to the three principal structures, which were found to be large volumes of the zone consisting of general points, away from symmetry points or lines.

22529 **Photoemission studies of the interaction of Li and solid molecular oxygen.** Qiu, S.L.; Lin, C.L.; Chen, J.; Strongin, M. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973-6000). *Physical Review [Section] B: Condensed Matter;* **39**: No. 9, 6194-6197(15 Mar 1989).

The interaction of Li and oxygen has been studied at 25 K. This system serves as an excellent prototype for studying the interaction of alkali metals with oxygen. For some of the alkali metals, such as Cs or K, oxygen can be incorporated below the metal surface and complex valence-band and core-level features are obtained. In the case of Li at 25 K this does not appear to happen, and the core-level and valence-band features can be identified with the formation of the superoxide, the peroxide, and the oxide.

22530 **Defect structures in cold worked and small grain pure and boron-doped Ni_3Al alloys.** Usmar, S.G.; Lynn, K.G. (Department of Applied Science, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Materials Research;* **4**: No. 1, 55-61(Jan 1989).

Positron lifetime spectroscopy was used to study the isochronal annealing of cold worked Ni_3Al samples. In pure Ni/sub 76/Al/sub 24/, Ni/sub 74/Al/sub 26/, and boron-doped Ni/sub 74/Al/sub 26/ three annealing stages were observed. Boron-doped Ni/sub 76/Al/sub 24/ showed only two annealing stages. Vacancy annealing (stage III) was identified in all cases to start at {similar←to}250 °C, somewhat higher than previously reported. The discrepancy is suggested to be due to carbon-vacancy interactions, because carbon (impurties) was observed to diffuse out of all samples at or above {similar←to}350 °C. The high-temperature annealing stage in boron-doped Ni/sub 74/Al/sub 24/ (which is ductile) starts at 700--750 °C and is complete at 1000 °C. This stage was attributed to migration of dislocations to various sinks. In pure Ni/sub 76/Al/sub 24/, Ni/sub 74/Al/sub 26/, and boron-doped Ni/sub 74/Al/sub 26/ (which are brittle) the intermediate and high-temperature annealing stages occur at {similar←to}750--800 and 1000 °C, respectively. These stages were attributed to the migration of dislocations (750--800 °C) and recrystallization ({similar←to}1000 °C) with incomplete annealing of dislocations at 1000 °C. This being the case, it is clear that dislocations interact with grain boundaries fare more strongly in brittle than in ductile Ni_3Al alloys. Thus, these data strongly suggest that the ductilization of Ni/sub 76/Al/sub 24/ by boron is largley due to a change in grain boundary structure which inhibits the pinning of dislocations at grain boundaries that occurs in pure Ni/sub 76/Al/sub 24/ (i.e., boron increase the susceptibility of grain boundaries to slip). Similar results for small-grain samples support this interpretation.

22531 **Computer simulation on surfaces and [001] symmetric tilt grain boundaries in Ni, Al, and Ni_3Al.** Chen, S.P.; Srolovitz, D.J.; Voter, A.F. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Materials Research;* **4**: No. 1, 62-77(Jan 1989).

We have used "local volume" (embedded atom) type potentials to study the surfaces and grain boundaries of Ni, Al, and Ni_3Al. The simulations show that with appropriately fit potentials, the surface and grain boundnary structure can be realistically calculated. The surface rippling and relaxation show good agreement with experiments. The energies of most surfaces and grain boundaries also agree with existing data. The structural unit model for grain boundaries in Ni_3Al shows the same generic units as in pure metals, but with large variations due to distortions and multiplicity. The utility of the structural unit model is thus more limited for alloys. The grain boundary energies were found to be the highest for Al-rich Ni_3Al grain boundaries, and depend significantly on the local composition of the grain boundary. The cusps in the grain boundary energy as a function of misorientation angle are different for different grain boundary stoichiometries. The Ni_3Al grain boundaries have approximately the same grain boundary energy and cohesive energy as that of Ni.

22532 **Deformation twinning in superlattice structures.** Yoo, M.H. (Metals and Ceramics Division, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee 37831). *Journal of Materials Research;* **4**: No. 1, 50-54(Jan 1989).

The role of twinning in deformation and fracture behavior of ordered intermetallic compounds has been investigated from a viewpoint based on the crystallography of twinning. The conjugate relationship between the order twinning and the active slip system at elevated temperatures is identified in all the ordered structures considered. Implications of this conjugate relationship on the strength and ductility of ordered alloys are discussed.

22533 **Cleavage fracture in an Al_3Ti-based alloy have the $L1_2$ structure.** George, E.P.; Porter, W.D.; Henson, H.M.; Oliver, W.C.; Oliver, B.F. (Metals and Ceramanics Division, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee 37831). *Journal of Materials Research;* **4**: No. 1, 78-84(Jan 1989).

Selected area electron channeling patterns were used to identify the cleavage planes in a polycrystalline Al-23Ti-6Fe-5V alloy, which is an Al_3Ti-based alloy having the $L1_2$ structure. Alloys like this one are of scientific and technological interest because they fracture by brittle transgranular cleavage, despite the availability of more than five independent slip systems in the $L1_2$ structure and their relatively low hardness when compared to ductile $L1_2$ alloys like Ni_3Al. Homogenized bars of the levitation zone melted and directionally solidified alloy were fractured at room temperature in three point bending. The fracture surfaces, which consisted almost entirely of brittle transgranular cleavage facets, were examined in a scanning electron miscroscope (SEM) equipped to take channeling patterns. An optical microscope with a short depth of focus was inserted in the SEM column just below the objective lens, and by focusing it on several points on the cleavage facets, it was possible to orient the facets normal to the optic axis of the SEM prior to taking the channeling patterns. Of the eight cleavage facets examined in this study, sixe were of the {110} type and two were of the {111} type. Although it cannot be said that these are the only two cleavage planes in this alloy, the availability of more than one plane with low cleavage strength contributes to the brittleness of this alloy. These results are examined in the light of theoretical treatments of cleavage fracture, and comparisons are made with earlier studies on other $L1_2$ materials.

22534 **Nanoindentation of silver-relations between hardness and dislocation structure.** Pharr, G.M.; Oliver, W.C. (Department of Materials Science, Rice University, P. O. Box 1892, Houston, Texas 77251). *Journal of Materials Research;* **4**: No. 1, 94-101(Jan 1989).

The depth dependence of hardness ion a well-annealed single crystal of silver has been characterized in nanoindentation experiments. The work is based on similar experiments performed by Chen and Hendrickson, but extends their results to indent depths on the nanometer scale. The hardness is generally found to increase with decreasing depth, with a rather sharp increase observed at depths indentation, the sharp rise in hardness is found to be associated with the disappearance of dislocation rosette patterns and any signs of near-surface dislocation activity, thereby suggesting that very small scale dindentation plasticity may take place by nondislocation mechanisms. However, order of magnitude calculations

show that possible alternatives, specifically, diffusional mechanisms, are too slow to make significant contributions. It is suggested that for very small indents, either the surface dislocation debris is quickly annealed out before it can be observed or indentation plasticity is accommodated entirely by subsurface dislocation activity.

22535 **Self-diffusion and impurity diffusion of fcc metals using the five-frequency model and the Embedded Atom Method.** Adams, J.B.; Foiles, S.M.; Wolfer, W.G. (Theoretical Division, Sandia National Laboratories, Livermore, California 94550). *Journal of Materials Research;* **4**: No. 1, 102-112(Jan 1989).

The activation energies for self-diffusion of transition metal (Au, Ag, Cu, Ni, Pd, Pt) have been calculated with the Embedded Atom Method (EAM); the results agree well with available experimental data for both mono-vacancy and di-vacancy mechanisms. The EAM was also used to calculate activation energies for vacancy migration near dilute impurities. These energies determine the atomic jump frequencies of the classic "five-frequency formula," which yields the diffusion rates of impurities by a mono-vacancy mechanism. These calculations were found to agree fairly well with experiment and with Neumann and Hirschwald's "T/sub m/" model.

22536 **Improved high temperature creep resistant austenitic alloy.** Maziasz, P.J.; Swindeman, R.W.; Goodwin, G.M. (to US Dept. of Energy). US Patent Application 7-193,705. 13 May 1988. 12p. Contract AC05-84OR21400. DE89009664 NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009664/JAW.

An improved austenitic alloy having in wt% 19-21 Cr, 30-35 Ni, 1.5-2.5 Mn, 2-3 Mo, 0.1-0.4 Si, 0.3-0.5 Ti, 0.1-0.3 Nb, 0.1-0.5 V, 0.001-0.005 P, 0.08-0.12 C, 0.01-0.03 N, 0.005-0.01 B and the balance iron that is further improved by annealing for up to 1 hour at 1150-1200{degree}C and then cold deforming 5-15%. The alloy exhibits dramatically improved creep rupture resistance and ductility at 700{degree}C. 2 figs.

22537 **Method for improving x-ray diffraction determinations of residual stress in nickel-base alloys.** Berman, R.M.; Cohen, I. (to Dept. of Energy). US Patent Application 7-186,422. 26 Apr 1988. 15p. Contract AC11-76PN00014. DE89009593 NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009593/JAW.

A process for improving the technique of measuring residual stress by x-ray diffraction in pieces of nickel-base alloys is discussed. Part of a predetermined area of the surface of a nickel-base alloy is covered with a dispersion. This exposes the covered and uncovered portions of the surface of the alloy to x-rays by way of an x-ray diffractometry apparatus, making x-ray diffraction determinations of the exposed surface, and measuring the residual stress in the alloy based on these determinations. The dispersion is opaque to x-rays and serves a dual purpose, since it masks off unsatisfactory signals such that only a small portion of the surface is measured, and it supplies an internal standard by providing diffractogram peaks comparable to the peaks of the nickel alloy so that the alloy peaks can be very accurately located regardless of any sources of error external to the sample. 2 figs.

22538 **Iron-niobium-aluminum alloy having high-temperature corrosion resistance.** Hsu, Huey S. (to Dept. of Energy). US Patent Application 7-181,630. 14 Apr 1988. 13p. Contract AC05-84OR21400. DE89009600 NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009600/JAW.

An alloy for use in high temperature sulfur and oxygen containing environments, having aluminum for oxygen resistance, niobium for sulfur resistance and the balance iron, is discussed. 4 figs., 2 tabs.

22539 **Thermodynamic and phase equilibria studies of the aluminum-antimony system.** Coughanowr, C.A.; Egan, J.J.; Anderson, T.J. (Brookhaven National Lab., Dept. of Applied Science, Upton, L.I., NY (US); Univ. of Florida, Chemical Engineering Dept., Gainesville, FL (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

The growing interest in the use of III-V compounds in semiconductor devices underscores the importance of determining the properties of these materials. To establish equilibrium boundary conditions for such processing steps as bulk crystal growth and liquid-phase epitaxy, knowledge of the phase diagrams and other thermodynamic properties is needed. In the present work, thermodynamic and phase equilibria data have been obtained for the Al-Sb system, using high-temperature electrochemical techniques.

22540 **The effect of alloy grain size on oxidation kinetics of an forming alloy.** Goedjen, J.J.; Shores, D.A. (Minnesota Corrosion Research Center, Univ. of Minnesota, 221 Church St., Minneapolis, MN (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

Alloy grain size is not usually regarded as having an important effect on oxidation rates. It has been demonstrated, however, that surface deformation, leading to a recrystallized, fine-grain surface layer, is beneficial in promoting the formation of a protective scale on alloys of marginal compositions. It was suggested that enhanced transport of alloying elements to the metal/scale interface, via grain boundary diffusion, accelerated the initial formation of the protective scale, which contributed to a subsequent reduction in the overall oxidation rate. It has also been demonstrated that a stainless steel prepared by powder metallurgy techniques using rapidly solidified powders, and therefore having a very fine grain size, exhibited greatly improved oxidation resistance as compared to conventionally prepared alloys of the same composition. In the present study the authors have examined the effect of alloy grain size on the rate of oxidation of a very oxidation-resistant alloy.

22541 **Segregation of alloying elements into the passive films on binary nickel alloys.** Macdonald, D.D.; English, C.; Pallix, J.; Ben-Haim, M. (SRI International, Menlo Park, CA (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

The role of alloying elements in modifying the resistance of structural metals to general and local corrosion is not fully understood, to the extent that corrosion resistant alloys cannot be designed from first principles. The development of this capability must await more detailed knowledge of the structural and electronic properties of the thin passive films that grow on corrosion-resistant metals and alloys. In this study, the authors investigated the segregation of Al/sup 3+/, Ti/sup 4+/, and Mo/sup 6+/ into the passive films that form on the dilute binary alloys Ni-X(X-Al, Ti, Mo) under potentiostatic conditions.

22542 **Surface instability under conditions of selective dissolution in a liquid metal environment.** Tortorelli, P.F. (Oak Ridge National Lab., P.O. Box 2008, Oak Ridge, TN (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

Selective dissolution of one or more components from an alloy (also referred to as dealloying) has been observed in aqueous, liquid metal, molten salt, and gaseous environments. In many of these cases, selective dissolution leads to the formation of a

"porous" or highly irregular surface zone on the exposed solid. It is shown that, for the specific case of austenitic stainless steel exposed to molten lead-lithium, a surface destabilization model best describes the observed corrosion morphology and the effect of cold work on this type of attack.

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REFER ALSO TO CITATION(S) 21933, 21995, 22478, 22479, 22497, 22674, 22831, 22846, 23023, 23724

22543 (BNL—42266) Quasielastic and inelastic spin fluctuations in superconducting La/sub 2-x/Sr/sub x/CuO_4. Birgeneau, R.J.; Endoh, Y.; Hidaka, Y.; Kakurai, K.; Kastner, M.A.; Murakami, T.; Shirane, G.; Thurston, T.R.; Yamada, K. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 11p. (CONF-8810256—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008157/JAW.

From 2. NEC symposium on fundamental approach to new material phases; Tokyo, Japan (24 Oct 1988).

We review the results of recent neutron scattering studies of the spin fluctuations in samples of La/sub 1.89/Sr/sub 0.11/CuO_4 which are {approximately}80% superconducting with T/sub c/ = 10 K. The structure factor, S({rvec Q}), reflects three dimensional modulated spin correlations with an in-plane correlation length of order 18 +- 6 {angstrom}. The fluctuations evolve with temperature from being predominantly dynamic at high temperatures to mainly quasielastic ({vert←bar}ΔE{vert←bar} < 0.5 MeV) at low temperatures. No significant differences are observed in the normal and superconducting states. 11 refs., 6 figs.

22544 (CONF-881125—5) Internal stresses in ceramic composite constituents determined by neutron diffraction technique. Singh, J.P.; Kupperman, D.S.; Majumdar, S. (Argonne National Lab., IL (USA)). Jun 1988. Contract W-31109-ENG-38. 18p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009883/JAW.

From 3. international symposium on ceramic materials and components for engines; Las Vegas, NV, USA (27 Nov 1988).

The volumetric internal strains in the constituents of two ceramic composites---SiC whisker-reinforced Al_2O_3 matrix and monoclinic ZrO_2 dispersed in cubic ZrO_2 matrix have been measured with the Argonne Intense Pulsed Neutron Source and Powder Diffractometer. The corresponding stresses were determined from strain measurements. The internal strains in Al_2O_3/SiC have been observed to relax with increasing temperature, extrapolating to zero strain at {approximately}1400{degree}C. For ZrO_2 composites, 0.29% compressive strain was measured in monoclinic ZrO_2 particles for composites with 4 wt % monoclinic ZrO_2 content. This strain was observed to relax to 0.12% at 10 wt % monoclinic ZrO_2 contents. It is believed that this strain relaxation is probably due to the microcracking of cubic ZrO_2 matrix as a result of large hydrostatic tensile stresses developed in the matrix at higher monoclinic ZrO_2 content. 12 refs., 7 figs., 1 tab.

22545 (CONF-881226—2) Processing and electrical properties of high-T/sub c/ superconductors. Poeppel, R.B.; Lanagan, M.T.; Singh, J.P.; Goretta, K.C.; Dusek, J.T.; Dorris, S.E.; Balachandran, U.; Bohn, C.L.; Delayen, J.R. (Argonne National Lab., IL (USA)). Sep 1988. Contract W-31109-ENG-38. 3p. NTIS, PC A02 - OSTI. Order Number DE89009852/JAW.

From 13. international conference on infrared and millimeter waves; Honolulu, HI, USA (5 Dec 1988).

This paper presents an overview of ceramic fabrication techniques and electrical properties of high-T/sub c/ superconductors. Fabrication of bulk ceramic and composite, a high-T/sub c/ superconducting wires and tapes is discussed. Direct-current critical current density data and surface resistance data at rf and microwave frequencies are presented for the YBa_2Cu_3O/sub 7{minus}x/ and $Ba_2Sr_2CaCu_2O$/sub 8+y/ phases. 13 refs., 1 fig.

22546 (CONF-890275—1) Structural properties of superconducting and nonsuperconducting Ba/sub 1-x/K/sub x/BiO_3. Dabrowsi, B.; Hinks, D.G.; Jorgensen, J.D.; Richards, D.R.; Pei, Shiyou; Zheng, Y.; Mitchell, A.W. (Argonne National Lab., IL (USA)). 1989. Contract W-31109-ENG-38. 18p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009813/JAW.

From 4. ultrastructure conference; Tucson, AZ, USA (19 Feb 1989).

Structural properties of Ba/sub 1-x/K/sub x/BiO_3 prepared by powder- and melt-process methods are studied. The potassium solubility limit, x = 0.5, is about the same for both methods and probably is determined by the ionic sizes of the constituent ions. Melt- and powder-processed samples of very good quality for superconducting compositions (x > 0.3) can be produced by melting or by repeated grinding, respectively and quenching after N_2 firing at 725{degree}C. Single phase samples for x < 0.3 can be made without reduction to the trivalent Bi-compound. Preparation of very homogeneous single phase samples for x < 0.3 is difficult due to the low N_2 synthesis temperatures and the phase separation which occurs above 725{degree}C. 11 refs., 7 figs.

22547 (CONF-8904103—1) Temperature effects on the break-in of nickel aluminide alloys. Blau, P.J.; DeVore, C.E. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005341/JAW.

From International conference on wear of materials; Denver, CO, USA (9 Apr 1989).

Nickel aluminide alloys are ordered intermetallic compounds which show promise for elevated temperature applications, some of which involve sliding contact. The present investigation was conducted to develop an understanding of the unlubricated sliding break-in behavior of three nickel aluminide alloys at room and elevated temperatures. In a particular, the variations in both the friction coefficient and the wear track morphology were studied. Pin-on-disk sliding experiments were conducted at room temperature and 923 K (650{degree}C) in air using fixed 9.5-mm-diam polycrystalline alumina balls as the pin material. Friction break-in behavior changed as the test temperature was increased. Friction coefficient changes corresponded to changes in the wear track morphology. At elevated temperatures, the oxidation of the disk surfaces affected the friction coefficient. Repeat runs on unworn parts of disks exposed to elevated temperatures had little effect on break-in behavior. 11 refs., 9 figs., 4 tabs.

22548 (DOE/CE/90001—3) The joint effect of surface microtopography and near-surface structure on microcontact conditions: Progress report for period September--November 1988. McCool, J.I. (SKF Industries, Inc., King of Prussia, PA (USA). SFK Tribonetics). Nov 1988. Contract AC02-87CE90001. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008516/JAW.

Surface documentation work has been completed on 1/3 of the 27 ceramic specimens that will be tested under this program. Indentation tests have been completed on another nine specimens. The indentation test results were examined critically and the constant in Auerbach's formula was deduced separately for each specimen. A tendency for this constant to be smaller for the polished specimens is noted. A preliminary appraisal is made of the relation between the measured wear values from the 9 pin-on-disk tests that have been completed to date and the predicted mean real contact area of a different but comparable set of specimens. The lowest measured wear was found to be associated with the lowest computed mean real contact pressure, but no more extensive trend could be discerned. Specimens have been obtained for Phase II testing and surface treatments and finishes have been tentatively selected. Microcontact model modifications needed for interpretation of Phase II tests are discussed. 2 refs., 2 figs., 1 tab.

22549 **(DOE/ER/45297—T1) Artifically structured superconductors: Annual progress report (revised January 11, 1989).** Falco, C.M. (Arizona Univ., Tucson (USA). Dept. of Physics). 14 Nov 1988. Contract FG02-87ER45297. 10p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009116/JAW.

We have succeeded in making high T/sub c/ films by three different techniques; sputtering from a stoichiometric YBa_2Cu_3O/sub 7-x/ target, sputtering from Y and Ba_2Cu_3 targets, and by co-evaporating BaF_2 while sputtering Y and Cu. The structure and composition of these films were characterized by a number of x-ray diffraction techniques, RBS, Auger and XPS. Physical properties measured included resistivity vs. temperature, electron tunneling, and infra-red optical reflectivity. Also during the past year, melt-processed Bi-Ca-Sr-Cu-O materials were fabricated and studied. A number of studies of low T/sub c/ metallic superlattices were completed this past year. These included development of improved techniques for their deposition, as well as studies of their structure, elastic properties, interfacial structure and growth dynamics, superconductivity, and electron tunneling. We reported the successful fabrication of the first "monolayer" metallic superlattice, consisting of alternating single atomic monolayers of Mo and Ta. Unlike all previous metallic superlattices, this monolayer superlattice maintained long range structural coherence and good metallic behavior. Also, we reported a new class of materials ("second order superlattices") with two superimposed superlattice wavelengths Λ_1 and Λ_2, and published a model of their x-ray diffraction spectra.

22550 **(DOE/ER/45312—1) Alumina reinforced tetragonal zirconia (TZP) composites: Progress report.** Shetty, D.K. (Utah Univ., Salt Lake City (USA). Dept. of Materials Science and Engineering). 1988. Contract FG02-87ER45312. 10p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008880/JAW.

During the past year, research progressed in three areas. These are (1) Studies of Interfacial Bonding and Sliding Friction in Ceramic-Matrix Composites, (2) Fabrication and Characterization of Al_2O_3 - Reinforced Zirconia Composites, and (3) Application of Electrical-Mechanical Analog to Composites. During this period, one technical paper appeared in the Journal of the American Ceramic Society and three other technical papers are in different stages of publication. A list of publications and their current status are given separately in this report.

22551 **(EUR—11716) Metallography and thermal analysis of ceramic nuclear fuels A handbook for laboratory assistants and research engineers.** Tebaldi, V. (Commission of the European Communities Karlsruhe (DE). European Inst. for Transuranium Elements). (Commission of the European Communities, Luxembourg). 1988. 389p. NTIS (US Sales Only), PC A17/MF A01. Order Number TI88757200/JAW.

The book contains two parts: the ceramography laboratory and the thermal treatment laboratory. After general remarks on sintering the first part includes sample preparation for ceramography (grinding, polishing, etching), microscopic examination and quantitative image analysis. The second part deals with temperature measurement, oxide/metal ratio determination, thermogravimetry, differential thermal analysis (DTA), melting point determination and constitution of phase diagrams. Installation of a Pu laboratory, sample decontamination, and research with a microprobe are described. 188 photomicrographs present the microstructure of ceramics based on U, Pu and higher actinides.

22552 **(FRCEA-TH—161) Thermal properties of some cerium compounds, particularly CeB/sub 6/.** Peysson, Y. (Grenoble-1 Univ., 38 (France)). Sep 1986. 495p. (In French). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88757353/JAW.

Using measurements of specific heat between 0.3 to 250K in the absence of a magnetic field, and from 2 to 250K for magnetic fields between 0 and 8T, it is shown that the γ 8 quadruplet is the fundamental level of the Ce/sup 3+/ ion, the γ 8-7 separation energy being of the order of 500K. Detailed analysis suggests a lifting of degeneracy of the multiplet γ 8 in the paramagnetic phase, according to usual processes. Specific heat results obtained at very low temperatures reveal the importance of a significant gap in the spin wave energy spectra. Measurements under a strong magnetic field, around the two magnetic phase transitions of CeB6 show a spectacular reinforcement of the specific heat anomaly at a temperature of the order of T/sub Q/. Thermal conductivity of CEB6 is also studied in relation to the possible existence of a Jahn-Teller effect, likely to affect heat transfer by phonons. The problem of the different components of thermal transport prompts the analysis of the Weidemann-Franz law in the Kondo net, and also the study of the thermal conductivity of the compounds CeCu6, CeA12, the alloys Ce/sub 0/./sub 7/5La/sub 0/./sub 25/B/sub 6/, Ce/sub x/La/sub 1-x/Cu/sub 6/, and the fluctuating valence system SmB/sub 6/. In all these bodies, an important contribution of phonons to electron transfer is shown. In the dense incoherent Kondo phase, it is not possible to envisage differences from the Weidemann-Franz law greater than those observed for highly diluted Kondo alloys.

22553 **(ICEFIZ-CS—12-1987) Superconductivity in the Ba sub(0.69) Y sub(0.46) Cu O sub(3.15-delta) compound.** Ursu, I; Labusca, E.; Mihai, I.; Novacu, A.; Petrascu, H.; Petrascu, M. (Institutul Central de Fizica, Bucharest (Romania)). (Central Inst. of Physics, Bucharest (Romania)). Oct 1987. 5p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706000/JAW.

High critical temperature Tsub(c)=119K and onset temperature T=135K was observed in Ba sub(0.69) Y sub(0.46) Cu O sub(3.15-delta) compound. This compound corresponds to the calculated admixture of 80% of the superconducting Ba/sub 2/ Y Cu/sub 3/ Osub(9-delta) phase, with 20% of the semiconductor Y/sub 2/ Ba Cu O/sub 5/ phase. A decrease in time was observed for Tsub(c), but also for the temperature width ΔT. The zero resistence point and the onset temperature are not significantly modified after a period of 3 months. (authors).

22554 (INIS-BR—1440, pp 12) **Preparation of superconductors at high temperature.** Bellido, A.V.; Auler, L.T.; Silva, B.F. da. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22555 (INIS-BR—1440, pp 35) **Preliminary study of radiation effect on superconductors.** Goncalves, Z.C.; Santos, G.R. dos; Barreto, J.; Mattievich, E.; Pereira, R.; Silveira, M. da. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22556 **(LA-UR—89-796) On the isotope effect in $YBa_2Cu_3O_7$: Measurements for two methods of synthesis.** Clarke, A.P.; Yvon, P.J.; Schwarz, R.B.; Thompson, J.D.; Meisenheimer, R.; Bernardez, L. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 11p. (CONF-890215—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009402/JAW.

From Fall meeting of the Metallurgical Society; Las Vegas, NV, USA (27 Feb 1989).

We prepared superconducting samples of $YBa_2Cu_3(^{18}O)$/sub 7-x/ and $YBa_2Cu_3(^{16}O)$/sub 7-x/ by two techniques: (a) burning powder of YBa_2Cu_3 in $^{18}O_2$ and $^{16}O_2$ and (b) crystallizing amorphous powder of $YBa_2Cu_3(^{16}O)$/sub 7.8/ in flowing $^{18}O_2$ and $^{16}O_2$. The percent of ^{18}O in the $YBa_2Cu_3(^{18}O)$/sub 7-x/ samples was 96.5 at.% for method (a) and 92 at.% for method (b). The $YBa_2Cu_3(^{16}O)$/sub 7-x/ samples had 99.8 at.% ^{16}O. Susceptibility measurements of the superconducting transition temperature show an oxygen isotope effect of 0.4 K for both methods.

22557 (LA-UR—89-825) Wear and friction of thin film high temperature oxide superconductors. Nastasi, M.; Hirvonen, J.-P.; Toivanen, R.O. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 14p. (CONF-890468—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009397/JAW.

From 16. international conference on metallurgical coatings and equipment exhibit; San Diego, CA, USA (17 Apr 1989).

We have examined the sliding properties of a Nd-Fe-B magnet against a thin film $YBa_2Cu_3O_7$ superconductor. Pin-on-disk experiments were performed at room temperature and in normal air using a 10 mm magnetic Nd-Fe-B ball loaded to 31.22 g and a sliding speed of approximately 0.57 cm/sec. Such condition produced a steady state friction coefficient of 1.1 +- 0.3. Wear rate measurements indicated that Nd-Fe-B will wear $YBa_2Cu_3O_7$ at a rate 1.3 {times} 10/sup {minus}14/ m^3/m and that the Nd-Fe-B/$YBa_2Cu_3O_7$ sliding system possess a wear coefficient of 4.2 {times} 10/sup {minus}14/ m^3/Nm. These unusually high values appear to be the result of both abrasive and adhesive wear. Adhesion between the sliding surfaces is most probably enhanced by the oxygen reactivity of the pin material and the high oxygen content in the superconductor. 3 refs., 5 figs.

22558 (LA-UR—89-995) Microwave processing of ceramics. Katz, J.D. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 10p. (CONF-890306—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009350/JAW.

From Industry-university advanced materials conference; Denver, CO, USA (6 Mar 1989).

This paper discusses the following topics on microwave processing of ceramics: Microwave-material interactions; anticipated advantage of microwave sintering; ceramic sintering; and ceramic joining. 24 refs., 4 figs. (LSP)

22559 (LBL—25893) The preparation and characterization of high surface area transition metal nitrides. Jaggers, C.H. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 249p. NTIS, PC A11/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009228/JAW.

In the preparation of new catalytic materials, maximizing the surface area is important to minimize the amount of catalyst needed. This study is concerned with the synthesis of high surface area molybdenum and vanadium nitrides by the reaction of oxide and ammonium oxide precursors with ammonia. The reactions have been followed using thermogravimetric analysis (TGA) and high temperature x-ray diffraction (XRD) to determine reaction intermediates, while the development of surface area was investigated by interrupting the TGA experiments and measuring the surface area using the BET method. 102 refs., 37 figs., 10 tabs.

22560 (ORNL/Sub—85-55901/01) Modeling of chemical vapor infiltration. Starr, T.L. (Oak Ridge National Lab., TN (USA); Georgia Inst. of Tech., Atlanta (USA)). Feb 1989. Contract AC05-84OR21400. 58p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009338/JAW.

Ceramic matrix composites can be fabricated by chemical vapor infiltration (CVI) of a fibrous preform. In conventional processing, the reactant gases diffuse into the preform under isothermal conditions, depositing material onto the fibers and forming a continuous matrix as coating thickness increases. This technique usually requires several weeks to achieve high density. Recent development of a forced flow, thermal gradient technique can reduce infiltration time to several hours. While successful composites have been produced, understanding of the process and its critical parameters is incomplete. In order to gain this insight an analytical model of this process is being developed. The developed CVI model will simulate the infiltration process based on input of the controlling process parameters and preform properties. Providing detailed information on the composition of the partially dense composite throughout the process period, the model will allow rapid selection of optimum processing conditions for a particular preform. Beyond this, the model also can be used to design the preform (geometry and fiber architecture) and the infiltration reactor. The CVI model is developed based on fundamentals of mass and heat transport and on the microstructure and physical properties of the preform and matrix materials. 36 refs., 28 figs., 2 tabs.

22561 (SAND—88-1797C) Interfacial reactions in ceramic-metal systems. Loehman, R.E. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 34p. (CONF-8810195—7). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009068/JAW.

From 41. Pacific coast regional meet of American Ceramic Society; San Francisco, CA, USA (24 Oct 1988).

Ceramic-metal and ceramic-ceramic joining are enabling technologies that allow the superior properties of ceramics to be exploited in areas where they otherwise might not be suited. More economical manufacture of complex structures, hermetic metal-insulator seals, metal-ceramic composites, and packaging of electronic devices are examples for which availability of ceramic-metal and ceramic-ceramic joining is critical to function. Rational control of ceramic joining requires an understanding of reaction and bonding mechanisms. This paper very briefly reviews the thermodynamic basis of wetting, adhesion, and interfacial reactions. Those general principles are used to interpret experimental results from three examples of ceramic-metal reactions relevant to joining and electroding: (1) glass-ceramic to metal reactions; (2) Si_3N_4-braze alloy reactions; and (3) AlN-metallization reactions. 35 refs., 11 figs., 3 tabs.

22562 (UCRL—100472) Shock compaction of YBa_2Cu_3O/sub 7-x/ and $HoBa_2Cu_3O$/sub 7-x/ powders in a metal matrix. Nellis, W.J.; Seaman, C.L.; Maple, M.B.; Early, E.A.; Holt, J.B.; Kamegai, M.; Smith, G.S.; Hinks, D.G.; Dabrowski, D. (Lawrence Livermore National Lab., CA (USA)). Feb 1989. Contract W-7405-ENG-48;W-31109-ENG-38. 18p. (CONF-890216—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008827/JAW.

From International symposium on high {Tc} superconducting oxides: processing and related properties; Las Vegas, NV, USA (27 Feb 1989).

Shock compaction of powders has several features with potential for processing high-J/sub c/ oxide superconductors. Because compaction occurs by applying 100 kbar pressures on fast μsec timescales, compressive energy and heating are localized on powder particle boundaries. By using single-crystallite particles the method could be used to heat and bond grain boundaries while maintaining their interiors cool and stable. Shock processing of ceramic powders produces defects and fine grain size, which might increase flux pinning and J/sub c/. This paper summarizes results of compactions using single-phase orthorhombic powder specimens of YBa_2Cu_3O/sub 7-x/ or $HoBa_2Cu_3O$/sub 7-x/ mixed with 30 vol % Ag. Each powder specimen weighed less than 0.2 g. Dynamic pressures in the range 29-217 kbar were generated by impact of a 5 g plastic projectile at velocities in the range 0.77-3.26 km/s. Projectiles were accelerated with a two-stage light-gas gun. Representative pressure histories were calculated with a two-dimensional finite-element computer code. X-ray diffraction, optical microscopy, magnetic susceptibility, and electrical resistance measurements were made on the recovered compacts. X-ray and magnetic data show these oxide powders to be robust to shock compaction, essentially maintaining their chemical and crystal structures, oxygen stoichiometry, and bulk superductivity to shock pressures well above 100 kbar. The dependence of magnetic susceptibility on shock pressure is interpreted by a decrease in grain size which is consistent with the optical microscopy. At 167 kbar some tetragonal phase is formed. 24 refs., 12 figs.

22563 (UCRL—100617) Effect of n on 1 laser treatment on damage threshold of selected optical coating. Wilder, J.G.; Thomas, I.M. (Lawrence Livermore National Lab., CA (USA)). 28 Feb 1989. Contract W-7405-ENG-48. 11p. (CONF-8810296—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008830/JAW.

From Boulder damage symposium; Boulder, CO, USA (26 Oct 1988).

Laser damage threshold improvement was observed in selected thin film coatings that were repeatedly irradiated by 1.06μm, 16 nsec pulse emitted by a laser with 30 Hz repetition rate. Each sample was first irradiated for one minute at separate sites (1 on 1 testing) to determine the laser damage threshold of the thin film. A separate site was multiply irradiated (n on 1 testing) using a pulse fluence that initially was arbitrarily low, then subsequently raised in

a step-wise fashion until damage occurred. Results indicate a significant increase in laser damage threshold of some thin film coatings due to this treatment. 5 refs., 7 figs.

22564 **Preferred orientation in experimentally deformed $YBa_2Cu_3O_6$/sub +//sub x/.** Wenk, H.; Pannetier, J.; Bussod, G.; Pechenik, A. (Department of Geology and Geophysics, University of California, Berkeley, California 94720). *Journal of Applied Physics;* **65**: No. 10, 4070-4073(15 May 1989).

Neutron diffraction data document that [001] axes of $YBa_2Cu_3O_6$/sub +//sub x/ in an experimentally deformed polycrystalline aggregate are preferentially aligned parallel to the compression direction. Preferred crystallographic orientation strongly affects oxygen stoichiometry results determined by structure refinement analysis of neutron diffraction data and appropriate corrections are necessary.

22565 **Synthesis of high-density Ba/sub 1-//sub x/K/sub x/BiO_3 superconducting samples.** Hinks, D.G.; Mitchell, A.W.; Zheng, Y.; Richards, D.R.; Dabrowski, B. (Argonne National Laboratory, Materials Science Division, Argonne, Illinois 60439). *Applied Physics Letters;* **54**: No. 16, 1585-1587(17 Apr 1989).

A synthesis procedure for producing high-density Ba/sub 1-//sub x/K/sub x/BiO_3 has been developed. A novel melt-processing technique is described which yields strong, near 100% dense superconducting material. This material is much more amenable to experimental study than the powder samples produced by the previous synthesis methods.

22566 **Evidence for the superconducting proximity effect in junctions between the surfaces of YBa_2Cu_3O/sub x/ thin films.** Moreland, J.; Ono, R.H.; Beall, J.A.; Madden, M.; Nelson, A.J. (National Institute of Standards and Technology, Electromagnetic Technology Division, Boulder, Colorado 80303). *Applied Physics Letters;* **54**: No. 15, 1477-1479(10 Apr 1989).

We have used the squeezable electron tunneling junction technique for testing the electrical properties of the surfaces of YBa_2Cu_3O/sub x/ (YBCO) thin-film electrodes. As deposited and annealed, the surfaces of the electrodes were insulating at 4 K. Several methods were used to improve the electrical properties of the electrodes' surfaces including rapid thermal annealing, oxygen sputter etching, and thin Ag coating treatments. The greatest improvement occurred after a deposition of a 5 nm Ag coating and subsequent rapid thermal anneal of one set of YBCO films. Under these conditions it was possible to make a superconducting Josephson point contact between the surfaces of the electrodes. We think that the Ag acts as a normal-metal proximity layer effectively shunting the degraded electrodes' surfaces.

22567 **Elastic constants of metal-insulator superlattices.** Bhadra, R.; Grimsditch, M.; Murduck, J.; Schuller, I.K. (Materials Science Division, Building 223, Argonne National Laboratory, Argonne, Illinois 60439). *Applied Physics Letters;* **54**: No. 15, 1409-1411(10 Apr 1989).

A Brillouin scattering study of elastic properties of NbN/AlN superlattices is presented. Because the coupling of light to surface waves in this system is very weak, we describe a modification of the technique which enhances the scattering efficiency, thereby allowing measurements of a system which is otherwise inaccessible. This particular multilayer superlattice is one of the very few that does not exhibit any elastic anomalies as a function of layer thickness in accordance with the idea that electron transfer may be the mechanism responsible for elastic anomalies in superlattices.

22568 **Characterization of Y-Ba-Cu-O superconducting thin films prepared by coevaporation of Y, Cu, and BaF_2.** Garzon, F.H.; Beery, J.G.; Brown, D.R.; Sherman, R.J.; Raistrick, I.D. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Physics Letters;* **54**: No. 14, 1365-1367(3 Apr 1989).

We have studied the effect of varying the postdeposition anneal conditions on the properties of thin films of $YBa_2Cu_3O_7$ prepared by coevaporation from Y, Cu, and BaF_2. The temperature of this processing step determines both the microstructure of the films and the constituent phases. At low temperatures, BaF_2 is incompletely reacted and the predominant superconducting phase is $Y_2Ba_4Cu_8O$/sub 20-//sub x/. At higher temperatures, the equilibrium distribution of phases, which includes $YBa_2Cu_3O_7$, is formed. As the temperature is raised, the texture of the films also changes. The thermodynamics of the formation reaction and of the reaction between $YBa_2Cu_3O_7$ and various substrate materials is discussed.

22569 **Transport in crystalline La_2CuO/sub 4+//sub δ/: Enormous anomalies at T/sub N/ for small hole doping.** Cheong, S.; Hundley, M.F.; Thompson, J.D.; Fisk, Z. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 10, 6567-6570(1 Apr 1989).

The anisotropic electrical resistivity rho and thermoelectric power S have been determined on single crystals of La_2CuO/sub 4+//sub δ/ in which the hole doping δ has been varied by controlled anneals. An enormous decrease and hysteresis in both rho and S occur at the Neel temperature T/sub N/ for small δ, suggesting strong coupling between magnetic order and transport. Possible origins of these transport anomalies are discussed.

22570 **Oxygen concentration effect on T/sub c/ of the Bi-Ca-Sr-Cu-O superconductor.** Morris, D.E.; Hultgren, C.T.; Markelz, A.M.; Wei, J.Y.T.; Asmar, N.G.; Nickel, J.H. (Physics Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 10, 6612-6614(1 Apr 1989).

The T/sub c/ of Bi_2-Ca-Sr_2-Cu_2-O/sub 8-//sub x/ can be shifted reversibly over a rangel of at least 15 K by changing the oxygen concentration. T/sub c/ shifts downward for increased oxygen content. This is opposite to the shift seen in YBa_2Cu_3O/sub 7-//sub δ/ and may be caused by reduction in the Fermi level reducing conductivity in the Bi-O layers. Oxygen concentration is varied by treatment in O_2 at appropriate pressures. The highest T/sub c/ = 78.5 K of the "80-K" phase is obtained by treating at 600 °C in 10/sup -2/-bar oxygen. T/sub c/ shifts down to 65.4 K after treatment at 137 bars. The transitions remain sharp, with no evidence of significant structural change by x-ray powder diffraction. The original T/sub c/ is restored upon retreatment in O_2 at low partial pressure. The 110-K phase showed a much smaller shift (ΔT/sub c/≅4 K) after treatment in O_2 at 134 bar.

22571 **Microstructure, lattice parameters, and superconductivity of YBa_2(Cu/sub 1-//sub x/Fe/sub x/)$_3O$/sub 7-//sub δ/ for $0 \leq x \leq 0.33$.** Xu, Y.; Suenaga, M.; Tafto, J.; Sabatini, R.L.; Moodenbaugh, A.R.; Zolliker, P. (Department of Applied Science, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 10, 6667-6680(1 Apr 1989).

Iron was substituted for copper in YBa_2(Cu/sub 1-//sub x/Fe/sub x/)$_3O$/sub 7-//sub δ/ for $0 \leq x \leq 0.33$. Superconducting transition temperatures and lattice parameters have been determined as a function of Fe content. The orthorhombic distortion $\Delta a_0 = 2(b-a)/(a+b)$ decreased to zero near x = 0.03. Beyond x = 0.03 the structure appears tetragonal. For compositions $0 \leq x \leq 0.15$ the superconducting critical temperature T/sub c/ decreased smoothly from T/sub c/ = 90 K to below 4.2 K. Transmission electron microscopy (TEM) revealed that the spacing between the twin boundaries decreased from {similar←to}200 nm for x = 0 to {similar←to}20 nm for x = 0.02 before the twins disappeared for x> = 0.03. The sharp streaks in TEM diffraction patterns were interpreted as due to the twin boundary layers whose thickness varied from {similar←to}1 nm for the pure to {similar←to}2 nm for the Fe (x = 0.02) containing specimen. A tweed structure in the TEM image and associated diffuse streaks along the <110> directions in electron diffraction pattern appeared for x>0.015. This observation suggests that the structure consists of fine (<5 nm) orthorhombic domains, each domain having the twinlike crystallographic relation with its neighbors. Rietveld refinement of powder neutron diffraction for x = 0.10 and 0.167 determined that Fe substituted primarily on the Cu "chain" site, and for every two atoms

of Fe substituted, approximately one extra oxygen is incorporated in the Cu-O plane.

22572 **Variation of electronic and atomic structures in $YBa_2(Cu/sub\ 1-//sub\ x/Fe/sub\ x/)_3O/sub\ 7-//sub\ \delta/$.** Yang, C.Y.; Heald, S.M.; Tranquada, J.M.; Xu, Y.; Wang, Y.L.; Moodenbaugh, A.R.; Welch, D.O.; Suenaga, M. (Department of Applied Science, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **39**: No. 10, 6681-6689(1 Apr 1989).

We present x-ray-absorption spectroscopy measurements of $YBa_2(Cu/sub\ 1-//sub\ x/Fe/sub\ x/)_3O/sub\ 7-//sub\ \delta/$, x = 0.015 to 0.15. Both near-edge features and extended x-ray-absorption fine-structure (EXAFS) results demonstrate that Fe preferentially substitutes for Cu(1) atoms at the linear-chain site. The compositional trend of these samples shows that the valence state of Fe (mainly +3, but the possible presence of small amounts of +2 and +4 cannot be ruled out) remains the same and Fe-O bond lengths change minimally in the light of changes in the lattice parameters with composition. Because of its sensitivity to coordination geometry, the reduction of the intensity of the 1s→3d edge feature indicates that the average coordination number of Fe nearest neighbors increases with increasing Fe content. EXAFS data analysis also finds an increase in the number of oxygen neighbors in the linear-chain plane, indicating an introduction of the extra oxygen atom on the vacancies of the a axis. Based on statistical considerations, we have examined the distribution of this extra oxygen atom as well as three possible Fe site coordination geometries (fourfold, fivefold, and sixfold).

22573 **Photoemission and inverse resonant photoemission studies of $Tl_2Ba_2Ca_2Cu_3O/sub\ 10+//sub\ y/$.** Meyer H.M. III; Wagener, T.J.; Weaver, J.H.; Ginley, D.S. (Department of Materials Science and Chemical Engineering, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review [Section] B: Condensed Matter;* **39**: No. 10, 7343-7346(1 Apr 1989).

We present photoemission and inverse photoemission results for single and polycrystalline $Tl_2Ba/sub\ 2-x/Ca/sub\ 2+//sub\ x/Cu_3O/sub\ 10+//sub\ y/$. Studies of the occupied states reveal Cu-O and Tl 6s hybrid states within {similar←to}8 eV of the Fermi level E/sub F/. Tl 4f emission characteristic of a single chemical environment, the Cu 2p/sub 3/2/ main line and satellites, complex O 1s emission derived from chemically inequivalent oxygen sites, and Ca and Ba emission reflecting Ca-Ba disorder within the unit cell were observed. Inverse-photoemission results show a low density of states within {similar←to}1 eV of E/sub F/ and structure at {similar←to}3, {similar←to}7, 9.6, and 14 eV above E/sub F/ that is associated with Tl 6p, Ba 5d, Ca 3d, and Ba 4f empty levels. Resonant inverse-photoemission highlights the O 2p holes near E/sub F/. Differences and similarities to $Bi_2Ca/sub\ 1+x/Sr/sub\ 2-//sub\ x/Cu_2O/sub\ 8+//sub\ y/$ are discusse

22574 **Eight new high-temperature superconductors with the 1:2:4 structure.** Morris, D.E.; Nickel, J.H.; Wei, J.Y.T.; Asmar, N.G.; Scott, J.S.; Scheven, U.M.; Hultgren, C.T.; Markelz, A.G.; Post, J.E.; Heaney, P.J.; and others. (Physics Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **39**: No. 10, 7347-7350(1 Apr 1989).

New high-temperature superconducting compounds $RBa_2Cu_4O_8$ (R = Nd, Sm, Eu, Gd, Dy, Ho, Er, and Tm) which share the 1:2:4 structure of $YBa_2Cu_4O_8$ are bulk synthesized using a new high-pressure oxygen technique. All compounds show substantial Meissner diamagnetism [(3--25) x 10/sup -4/ emu/g at 20 K]. Critical temperatures (57--81 K) vary inversely with ion size (opposite to 1:2:3), and directly with orthorhombic distortion (which is much smaller than in corresponding 1:2:3 compounds). $R_2Ba_4Cu_7O/sub\ x/$ compounds (with alternating blocks of 1:2:3: and 1:2:4) were also prepared. The variable oxygen stoichiometry of 1:2:3 is not shared by the 1:2:4 compounds.

22575 **Resonant-photoemission study of $Ba/sub\ 0.6/K/sub\ 0.4/BiO_3$.** Ruckman, M.W.; Di Marzio, D.; Jeon, Y.; Liang, G.; Chen, J.; Croft, M.; Hegde, M.S.; Barboux, P. (Materials Science Division, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **39**: No. 10, 7359-7362(1 Apr 1989).

Synchrotron-radiation photoemission results for the 29-K superconductor $Ba/sub\ 0.6/K/sub\ 0.4/BiO_3$ are reported for the 14- to 135-eV photon-energy range. Resonant photoemission is used to identify shallow core levels and atomic contributions to the valence band. The results are compared to a recently published band-structure calculation.

22576 **Theory for oxygen content and ordering in $YBa_2Cu_3O/sub\ 6+//sub\ x/$ in equilibrium with oxygen gas.** Shaked, H.; Jorgensen, J.D.; Faber J. Jr.; Hinks, D.G.; Dabrowski, B. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **39**: No. 10, 7363-7366(1 Apr 1989).

A model using statistical thermodynamics is presented which quantitatively describes the oxygen content and ordering in $YBa_2Cu_3O/sub\ 6+//sub\ x/$. This model is in good agreement with experiments within a broad range of temperature and oxygen partial pressure. In the framework of this model it is found that the site (binding) energy of the oxygen in the lattice is quadratic in the oxygen concentration and linear in the temperature. A possible relation of this dependence to the electronic structure of $YBa_2Cu_3O/sub\ 6+//sub\ x/$ is discussed.

22577 **Spin susceptibility in superconducting $YBa_2Cu_3O_7$ from /sup 63/Cu Knight shift.** Takigawa, M.; Hammel, P.C.; Heffner, R.H.; Fisk, Z. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **39**: No. 10, 7371-7374(1 Apr 1989).

The /sup 63/Cu Knight shift in $YBa_2Cu_3O_7$ has been measured at both Cu(1) (chain) and Cu(2) (plane) sites, using a uniaxially aligned powder. The isotropic part of the spin Knight shift (K/sub s/) was found to be positive for both sites, suggesting large transferred hyperfine fields from oxygen p states. The Knight shifts at both sites show significant change below T/sub c/, indicating important roles of both the planes and chains in the superconductivity. Despite the uncertainty in the diamagnetic screening, the axial part of K/sub s/ at Cu(2) sites is found to show linear-T behavior at low temperatures.

22578 **Oxygen isotope effect in $YBa_2Cu_3O_7$ prepared by burning YBa_2Cu_3 in /sup 16/O and /sup 18/O.** Yvon, P.J.; Schwarz, R.B.; Pierce, C.B.; Bernardez, L.; Conners, A.; Meisenheimer, R. (Center for Materials Science and P-10, Los Alamos National Laboratory, Mail Stop K-765, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **39**: No. 10, 6690-6693(1 Apr 1989).

We prepared YBa_2Cu_3 powder by ball milling a 2:1 molar mixture of the intermetallics BaCu and CuY. We synthesized $YBa_2Cu_3(/sup\ 16/O)/sub\ 7-//sub\ x/$ and $YBa_2Cu_3(/sup\ 18/O)/sub\ 7-//sub\ x/$ by oxidizing the YBa_2Cu_3 powder in /sup 16/O and /sup 18/O. The /sup 16/O//sup 18/O ratios were determined by laser-ionization and sputtering-ionization mass spectroscopy. The $YBa_2Cu_3(/sup\ 16/0)/sub\ 7-//sub\ x/$ sample had 99.8 at. %/sup 16/O, and the $YBa_2Cu_3(/sup\ 18/O)/sub\ 7-//sub\ x/$ sample had 96.5 at. %/sup 18/O. Susceptibility measurements of the superconducting transition temperature (T/sub c/) = 91.7 K for /sup 16/O; half-point transition at 84 K show an isotope effect of 0.4 +- 0.1 K.

22579 **Superconductivity, intergrain, and intragrain critical current densities of materials.** Thompson, J.R.; Brynestad, J.; Kroeger, D.M.; Kim, Y.C.; Sekula, S.T.; Christen, D.K.; Specht, E.D. (Solid State Division, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee 37831-6061). *Physical Review [Section] B: Condensed Matter;* **39**: No. 10, 6652-6659(1 Apr 1989).

Bulk sintered and powdered samples of the high-temperature superconductive compounds $Tl_2Ca_2Ba_2Cu_3O/sub\ 1+//sub\ \delta/$ (Tl-2:2:2:3) and $Tl_2Ca_2Ba_2Cu_2O/sub\ 8+//sub\ \delta/$ (Tl-2:1:2:2) have been synthesized with phase purity of approximately 90%. The materials

were characterized by x-ray-diffraction, metallographic, and electron microprobe analyses. The electronic and superconductive properties were investigated through measurement of the electrical resistivity and the critical current density J/sub c/ using transport methods and by extensive magnetization measurements. Primary results and conclusions are that (1) the intragrain J/sub c/ values were large, much larger than the transport values; (2) both sintered and powdered materials exhibited large flux creep; (3) and the J/sub c/ decreased exponentially with temperature. These features are qualitatively very similar to those found in the corresponding YBa_2Cu_3O/sub z/ (with z≅7) series of compounds.

22580 **Elastic properties of flux lattices in anisotropic high-T/sub c/ superconductors.** Kogan, V.G.; Campbell, L.J. (Ames Laboratory and Physics Department, Iowa State University, Ames, Iowa 50011). *Physical Review Letters;* **62**: No. 13, 1552-1555(27 Mar 1989).

The elastic moduli of the two-dimensional flux-line lattice in a uniaxial superconductor are evaluated for an arbitrary orientation of vortices (i.e., of the magnetic induction) within the crystal in intermediate fields. For the flux lines in the basal a-b plane the ratio of the simple shear moduli, corresponding to displacements normal and parallel to the basal plane, is shown to equal $(m_3/m_1)^2$ where m_3 and m_1 are the masses along the c axis and the basal plane, respectively. For $YBa_2Cu_3O_7$ this amounts to a factor exceeding 600. The uniaxial crystal symmetry defines a preferred orientation to the flux lattice and doubles the number of independent elastic constants.

22581 **Formation, motion, and high-temperature superconductivity of large bipolarons.** Emin, D. (Sandia National Laboratories, Albuquerque, New Mexico 87185-8500). *Physical Review Letters;* **62**: No. 13, 1544-1547(27 Mar 1989).

Although small (spatially compact) bipolarons readily localize, large bipolarons (like large polarons) can be mobile. As such, large bipolarons are a suitable basis for bipolaronic superconductivity. However, large bipolarons can only form in multidimensional ionic solids if the static dielectric constant greatly exceeds twice the optical dielectric constant. The formation as well as normal-state and superconducting properties of large bipolarons appear consistent with observations of the high-temperature superconductors.

22582 **Multiple-scattering approach to the M-edge x-ray-absorption spectra of UO_2 and UCl_4.** Guo, J.; Ellis, D.E.; Alp, E.; Soderholm, L.; Shenoy, G.K. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60208). *Physical Review [Section] B: Condensed Matter;* **39**: No. 9, 6125-6139(15 Mar 1989).

The M-edge x-ray-absorption near-edge spectra was calculated for bulk UO_2 and gas-phase UCl_4 from a multiple-scattering approach within the muffin-tin--potential approximation. The muffin-tin potential was constructed from the self-consistent relativistic discrete-variational Xα potential. The spectra were interpreted by analyzing the photoelectron-trapping time in different channels inside each atomic sphere. The energy levels of bound states down to the valence levels of the ligands were calculated within the same framework as the continuum in order to set the absolute energy scale. The calculated spectra were compared and found to agree quantitatively with our experimental results.

22583 **Thermodynamics of the superconducting phase transformation in high T/sub c/ ceramanics with magnetoelectric effects.** Burns, S.J. (Materials Science Program, Department of Mechanical Engineering, University of Rochester, Rochester, New York 14627). *Journal of Materials Research;* **4**: No. 1, 33-38(Jan 1989).

A second order phase transformation in a dielectric ceramic superconductor is shown to relate jumps in physical properties to the ratio of state variables, i.e., to the phase boundary, near the critical point. The major jumps in specific heat, compressibility, permittivity, permeability, and spinodal composition curvature, between the normal and superconducting phases, are found from the continuity of the entropy, volume, electromagnetic fields (with zero fields), and chemical equilibrium. The thermal expansion, pyroelectric effects, and the piezoelectromagnetic effects are important differences between ceramanic and metallic superconductors. The most important conclusions from experimental measurments are that the lattice plays a minor role in the superconductor transformation while the magnetoelectric jump may be related to the jump in permeability, i.e., the Meissner effect, and the jump in permittivity. The oxygen miscibility gap which controls order/disorder transformations thermodynamically mandate that only mestastable compositions are obtained in the metal oxide, so absolute stability of the system may never be achieved. An explicit criterion to suggest other superconductor systems is given from magnetoelectric materials, i.e., some of the pervoskites.

22584 **Infrared absorption spectroscopy of hydrogen and deuterium in CaO and SrO crystals.** Park, J.L.; Gonzalez, R. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831 and Department of Physicss and Department of Materials Science and Engineering, North Carolina State University, Raleigh, North Carolina 27695). *Journal of Materials Research;* **4**: No. 1, 224-231(Jan 1989).

Infrared absorption spectra have been used to characterize OH- and OD- ions at the surface and the bulk of undoped CaO, lithium doped Cao, and SrO crystals. Diffusion of deuterons from D_2O vapor into these crystals was performed at elevated temperatures. Diffusion coefficients were obtained to be D (CaO) = 3 x 10/sup -6/ cm^2/sec at 1773 K and D(SrO) = 4 x 10/sup -7/ cm^2/sec at 1523 K. For the doped CaO crystal with lithium concentration of 310 ppm, the diffusion coefficient was measured to be D(CaO:Li) = 4 x 10/sup -7/ cm^2/sec at 1473 K and the activation energy in the Arrhenius equation was estimated to be 1.7 eV.

22585 **Surface composition of silicon carbide powders and whiskers: An XPS study.** Taylor, T.N. (Chemical and Laser Sciences Division, Los Alamos National Labortory, Los Alamos, New Mexico 87545). *Journal of Materials Research;* **4**: No. 1, 189-203(Jan 1989).

The surface composition and bonding of a wide variety of silicon carbide powders and whiskers have been characterized by x-ray photoelectron spectroscopy (XPS). Ultrafine SiC powders, grown by a radio frequency plasma process, have been shown to exhibit graphitic carbon and a thin suboxide coating. Wishers of SiC, grown in a vapor-liquid-solid or proprietary commercial process, were gnerally covered by heavier oxides than the powders and to a variable degree showed silica-like bonding. Most of the materials were subject to sample charging. Procedures were developed to estimate these charging effects and interpret the complete catalog of XPS spectra from these materials with respect to Fermi-level assignments. Charge independent quantities, such as oxygen Auger parameter and O(1s)-Si(2p) peak position difference, were found to agree with accepted values in the literature while exhibiting trends consistent with suboxide and silica bonding assignments. The data give a broad basis for understanding the feedstock surface chemistry which is involved during fabrication of monolithic or composite silicon carbide materials.

22586 **Process for making transition metal nitride whiskers.** Bamberger, C.E. (to US Dept. of Energy). US Patent Application 7-180,753. 12 Apr 1988. 13p. Contract AC05-84OR21400. DE89009596 NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009596/JAW.

A process for making metal nitrides, particularly titanium nitride whiskers, using a cyanide salt as a reducing agent for a metal compound in the presence of an alkali metal oxide. Sodium cyanide, various titanates and titanium oxide mixed with sodium oxide react to provide titanium nitride whiskers that can be used as reinforcement to ceramic composites. 1 fig., 1 tab.

22587 **A novel approach to abrasion resistance.** Steele, W.A.; Mohr, P.B.; Leider, H.R.; Hirschfeld, T.B. (Lawrence Livermore National Lab., Livermore, CA (US)). pp v of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y. New York, NY; American Society of Mechanical Engineers (1988). (CONF-880702—).

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Technical Paper 889316.

The high abrasion and impact loads characteristic of many technologies require frequent maintenance or special materials. Conventional approaches to protection have used either extremely hard coatings or compliant elastomeric coatings. The former are typically ceramic or ceramic-like surfaces produced by direct deposition or by in situ formation by oxidation, carburization or nitriding. Ceramic coatings are very good against abrasion, but are vulnerable to impact damage. Elastomeric coatings have excellent impact resistance and are capable of withstanding deformation; however, they are limited in thermal range and chemical resistance. It is possible to combine the desirable properties of both types by using hair, a structure in which an extremely hard material can be simultaneously elastic and compliant by virtue of a very high L/D ratio. They have demonstrated the good performance of carbon fiber hair in resisting damage from impacting particles and have identified a probably failure mechanism.

3606 Other Materials

REFER ALSO TO CITATION(S) 21698, 21729, 21773, 21775, 21830, 21830, 21926, 21926, 21929, 21964, 21995, 22255, 22497, 22582, 22587, 22658, 22675, 22683, 22684, 22793, 22831, 23015, 23040

22588 **(BNL—42371) Polymer electrolytes with exclusively cationic conductivity.** Liu, H.; Okamoto, Y.; Skotheim, T.; Pak, Y.S.; Greenbaum, S.G.; Adamic, K.J. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 5p. (CONF-881155—54). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009521/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

The synthesis of exclusively cation conducting polymer electrolytes based on a nylon-1 backbone, ethylene-oxide side chains, and attached dibutyl phenolate anions is described. The tendency for ion pair formation appears to be reduced as the conductivity of the sodium-containing compound reaches {approximately}2 {times} 10/sup {minus}6/ S-cm/sup {minus}1/ at 50{degree}C. ^{23}Na nuclear magnetic resonance measurements demonstrate: (1) motional narrowing of the mobile Na^+ resonance above the glass transition temperature; (2) mobile Na^+ concentrations of {approximately}75% at 40{degree}C; and (3) insensitivity of the linewidth to applied hydrostatic pressure up to 2 kbar. Similarities between these findings, and those in "conventional" polymer-salt electrolytes are discussed. 14 refs., 5 figs.

22589 **(BNL—42406) Radiation damage in barium fluoride detector materials.** Levey, P.W.; Kierstead, J.A.; Woody, C.L. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 11p. (CONF-8810246—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009523/JAW.

From Symposium on optical materials for high power lasers; Boulder, CO, USA (26 Oct 1988).

To develop radiation hard detectors, particularly for high energy physics studies, radiation damage is being studied in BaF_2, both undoped and doped with La, Ce, Nd, Eu, Gd and Tm. Some dopants reduce radiation damage. In La doped BaF_2 they reduce the unwanted long lifetime luminescence which interferes with the short-lived fluorescence used to detect particles. Radiation induced coloring is being studied with facilities for making optical measurements before, during and after irradiation with ^{60}C0 gamma rays. Doses of 10^6 rad, or less, create only ionization induced charge transfer effects since lattice atom displacement damage is negligible at these doses. All crystals studied exhibit color center formation, between approximately 200 and 800 nm, during irradiation and color center decay after irradiation. Thus only measurements made during irradiation show the total absorption present in a radiation field. Both undoped and La doped BaF_2 develop damage at minimum detectable levels in the UV---which is important for particle detectors. For particle detector applications these studies must be extended to high dose irradiations with particles energetic enough to cause lattice atom displacement damage. In principle, the reduction in damage provided by dopants could apply to other applications requiring radiation damage resistant materials.

22590 **(CONF-8904111—6) Emission properties of europium-doped lanthanum and lutetium orthophosphate crystals for use in high temperature sensor applications.** Bugos, A.R.; Allison, S.W.; Cates, M.R. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400;W-7405-ENG-36. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008736/JAW.

From Southeastcon '89 conference and exhibition; Columbia, SC, USA (9 Apr 1989).

The emission properties of two crystalline europium activated thermographic phosphors, lanthanum phosphate ($LaPO_4:Eu^{3+}$) and lutetium phosphate ($LuPO_4:Eu^{3+}$) have been investigated for potential use in high temperature remote thermometry applications. Emissions and excitation spectra were taken for both crystals at room temperature and at elevated temperatures. In the excitation spectra taken from room temperature to approximately 400{degree}C, lanthanum phosphate and lutetium phosphate exhibit a significant temperature-dependent shift in their charge-transfer (C-T) absorption bands. 10 refs., 9 figs.

22591 **(DOE/ER/13181—3) [The hydrophobic character of nonsulfide mineral surfaces as influenced by double-bond reaction of adsorbed unsaturated collector species].** (Utah Univ., Salt Lake City (USA). Dept. of Metallurgy). [1988]. Contract FG02-84ER13181. 32p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009218/JAW.

The primary objective of this research is to improve the flotation efficiency of nonsulfide mineral systems by establishing the fundamental features of collector adsorption reactions and developing appropriate chemical control strategies. In-situ real-time spectroscopic measurements, microcalorimetry, and surface modification have been used to accomplish this goal. Using these techniques, measurements have been completed to establish important fundamental information on nonsulfide flotation systems. In this regard, an innovative in-situ FTIR spectroscopy procedure which can detect adsorption from very dilute collectors solutions ({approximately}5{times}10/sup {minus}7/ M) is being developed to simultaneously study collector adsorption kinetics, equilibrium collector adsorption density, and collector orientation in-situ. Few researchers have taken this approach, and none have applied this method to the analysis of flotation phenomena. 13 refs., 12 figs., 12 tabs.

22592 **(DOE/ER/45366—1) The structural basis for fatigue initiation in glassy polymers: Progress report, August 1, 1988--February 28, 1989.** Yee, A.F.; Gidley, D.W. (Michigan Univ., Ann Arbor (USA)). 28 Feb 1989. Contract FG02-88ER45366. 10p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009292/JAW.

Experiments have been conducted to quickly establish whether physical aging is indeed accelerated by fatigue loading. Differential Scanning Calorimetry (DSC) experiments were run on a polycarbonate specimen fatigued at 200 to 2000 psi (tension-tension) at 2 Hz for 150,000 cycles and compared with a specimen exposed to an identical thermal history but no mechanical loading. A larger peak is found in the DSC trace of the fatigued specimen. The existence of a peak is typical of glassy materials subjected to physical aging. The larger peak is equivalent to aging for longer periods of time. These results establish clearly the occurrence of fatigue accelerated physical aging. To assess the extent to which this aging retards the shear yielding tendency of the glass, stress relaxation experiments are planned. Preliminary experiments have been performed to establish correct testing procedures. 4 figs.

22593 **(LA-UR—88-3990) The synthesis of polymeric surfactants for the operations of sterically-stabilized polyaniline colloids.** Armes, S.P.; Aldissi, M. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 10p. (CONF-890401—3). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003600/JAW.

From 197. national meeting of the American Chemical Society; Dallas, TX, USA (9 Apr 1989).

Since 1986 several groups have described the preparation of spherical sub-micronic polypyrrole colloids in aqueous media. These polypyrrole particles were sterically-stabilized by an outer

layer of physically adsorbed macromolecular surfactant [e.g., methylcellulose, poly(vinyl alcohol-co-vinyl acetate), poly(vinyl pyrrolidone), poly(4-vinyl pyridine-co-butyl methacrylate) etc.]. However, most of these stabilizers cannot be used to prepare polyaniline colloids under similar reaction conditions. Recently we have reported the preparation of colloidal polyaniline using a tailor-made random copolymer containing pendant aniline groups. In the present work we describe two general methods for the synthesis of such stabilizers. In addition we present the first spectroscopic evidence that these pendant aniline groups participate in the in situ aniline polymerization, resulting in chemical grafting of the stabilizer to the polyaniline particles. 11 refs., 3 figs., 2 tabs.

22594 **(LA-UR—89-1125) Water-processable conducting polymers.** Armes, S.P.; Aldissi, M. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 6p. (CONF-8904138—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009251/JAW.

From NATO advanced study institute on phase transitions in soft condensed matter; Geilo, Norway (4 Apr 1989).

Until recently, most organic conducting polymers suffered from the lack of processability which is a prerequisite for their use in most technological applications. Furthermore, processability is of importance for the study of the polymers' intrinsic properties. Because of the rigid nature of their backbones, processing of most of the initial undoped systems was successful. For doped polymers, the difficulties were even greater because doping causes further aggregation due to increased interchain interaction and certain local geometry changes of the chains. Therefore, we have utilized various methods to achieve processability, directly or indirectly. The discussion is limited to the use of small or polymeric surfactant molecules grafted or physically absorbed onto the conducting polymer chain or particle. Both solutions and colloidal dispersions are the subject of this brief discussion. 7 refs., 4 figs.

22595 **(LBL—26064) Structural changes of oxide films during anodization of P doped silicon in aqueous ammonium fluoride.** Crocker, R.W.; Muller, R.H. (Lawrence Berkeley Lab., CA (USA)). Sep 1988. Contract AC03-76SF00098. 23p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008851/JAW.

The growth and structural changes of the silicon dioxide film on boron doped silicon have been investigated during electrochemical oxidation in acidic ammonium fluoride solution. A high-speed spectroscopic ellipsometer was employed to obtain in-situ measurements while the silicon was subjected to anodic potential steps. These observations indicate that silicon dioxide does not dissolve in 0.10 M ammonium fluoride solution as acidic as pH 3.5. An alternative model to dissolution-limited film growth is proposed. 12 refs., 8 figs., 1 tab.

22596 **(LBL—26133) Electrical conduction and corrosion processes in fast lithium ion conducting glasses: Final report.** Tuller, H.L. (Lawrence Berkeley Lab., CA (USA); Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). Sep 1988. Contract AC03-76SF00098. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008850/JAW.

The primary approaches have been pursued towards preparing fast lithium ion conducting glasses with improved stability towards lithium attack. In the first approach we have modified the bulk composition of lithium metaborate glasses by the addition of CaO which is, on its own, stable in molten lithium. Electrochemical studies of the composition (50-x)Li_2O{center←dot}xCaO{center←dot}50B_2O_3 with maximum x = 8 mol% show it to be stable. Extensions to highly conductive, but less stable chloroborates are being pursued to test the stabilizing character of CaO more critically. An alternative approach being pursued for finding highly conducting but stable glass systems is to "apply" a passivation layer to a highly conductive but less stable base glass. Lithium metaborate and lithium chloroborate glasses have been ion exchanged in $Ca(NO_3)$-$LiNO_3$ molten salt baths to enrich their surfaces with CaO. Glasses exchanged in this manner remained transparent and exhibited no signs of devitrification. ESCA profiles on the metaborate confirm exchange to a depth of a least 1 μm. Preliminary tests in our double electrochemical cell indicate that glasses normally susceptible to Li attack can be stabilized by Ca ion exchange. Further experiments are being run to confirm these results and to establish optimum exchange conditions. 12 refs., 7 figs., 2 tabs.

22597 **(LBL—26336) δZ-$Y_2Si_2O_7$ structure confirmed by processing and simulation of atomic-resolution images.** Rai, R.S.; O'Keefe, M.A.; Thomas, G. (Lawrence Berkeley Lab., CA (USA)). Feb 1989. Contract AC03-76SF00098. 8p. (CONF-881155—51). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009057/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

High resolution electron micrographs have been obtained in various orientations for δ_2-$Y_2Si_2O_7$ using the Atomic Resolution microscope (ARM) at the National Center for Electron Microscopy (NCEM). These ARM images were processed by masking the diffractogram of the digitized image in Fourier space and applying an inverse transform (using the SEMPER program at the NCEM Image Analysis Facility) in order to reveal details obscured by amorphous contrast originating in the glassy matrix. Processed experimental images from very thin regions of the crystalline phase were compared with images simulated from postulated models (SHRLI images); close agreement was obtained. 12 refs., 7 figs

22598 **(MLM—3581) Epoxylite 8822 hardness study.** Sterrett, M.E.; Leahy, B.T.; Ryan, D.J. (EG and G Mound Applied Technologies, Miamisburg, OH (USA)). 31 Mar 1989. Contract AC04-88DP43495. 16p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008961/JAW.

A study of Epoxylite 8822 was conducted to investigate several properties of the epoxy curing process and their effects on hardness. The epoxy is used in numerous Mound timer programs, and the study was performed to determine the most effective and efficient curing process. The cure time, batch, and day and their interactions were examined to determine their contributions to hardness. Data from the investigation support the feasibility of verification trials using a 12-hr initial cure followed by additional cures to further determine the optimal cure time. 6 figs., 7 tabs.

22599 **(NP—9770307) Effects of surface preparation on the desorption and reaction behaviour of nitrogen and ammonia on osmium(0001).** Bolwin, K. (Osnabrueck Univ. (Germany, F.R.)). 1986. 160p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE89770307/JAW.

The decay of the adsorbed ammonia at differently structured Os(0001)-surfaces was investigated in the paper on hand. First, these investigations dealt with the characterization of the different osmium surfaces and the determination of the defect densities of those. These measurements were carried out with the low-energy electron diffraction (LEED). For the determination of the electronic characteristics of the pure osmium surface, the method of the bremsstrahlung-induced Auger electron spectroscopy (BAES) was used in addition to the photoelectron spectroscopy (PES) and Auger electron spectroscopy (AES). The experiments at the surfaces covered by adsorbates were finally carried out with the help of the photoelectron spectroscopy (XPS, UPS) and the thermic desorption spectroscopy (TDS). The XPS-investigations at the Os-surface covered with ammonia showed the successive decay of the NH/sub 3/-molecule a process in which the radicals NH/sub 2/ and NH as intermediate products as well as the atomically adsorbed nitrogen as final product because of the dislocation of the Nls bond energies could be detected. The experiments showed a high activation energy for the decay of the adsorbed NH towards the atomically bound nitrogen in dependence on the structure of the surface.

22600 (RAL—88-095) Neutron spectroscopy study of magnetic excitations in uranium oxysulfide. Amoretti, G.; Blaise, A.; Caciuffo, R.; Fournier, J.M.; Larroque, J.; Osborn, R. (Palermo Univ. (Italy). Ist. di Fisica; CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale; Ancona Univ. (Italy). Dipt. di Scienze dei Materiali e della Terra; Universite Scientifique et Medicale, Grenoble (France); CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). (Rutherford Appleton Lab., Chilton (UK)). Dec 1988. 26p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706126/JAW.

A neutron spectroscopy experiment has been performed to observe the position of the crystal field levels in both the paramagnetic and antiferromagnetic phases of UOS (uranium oxysulfide). The J = 4 ground manifold undergoes an overall splitting of about 100 meV in agreement with the predictions of a crystal field model used to analyze specific heat data. Above T/sub N/, two main peaks are observed at 74 and 82 meV with a shoulder at about 87 meV. Below T/sub N/ there is a redistribution of intensity together with a shift of the peak positions to 76, 84 and 92 meV at T = 30K. The experimental observations are interpreted in the framework of a refined crystal field model.

22601 (SAND—88-0943C) Monitoring thin film properties with surface acoustic wave devices: Diffusion, surface area and pore size distribution. Frye, G.C.; Martin, S.J.; Ricco, A.J.; Brinker, C.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 21p. (CONF-880912—28). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009379/JAW.

From 196. American Chemical Society national meeting; Los Angeles, CA, USA (25 Sep 1988).

The ability of surface acoustic wave (SAW) devices to monitor adsorption of N_2 onto the surfaces of porous films and diffusion of species into polymer films has been demonstrated. Calculations based on the N_2 adsorption isotherms illustrate how sol-gel solution chemistry can be used to tailor the surface area and pore size distribution of thin films. BET surface areas from unity to over 30 cm^2/cm^2 of film have been obtained with median pore diameters from less than 0.4 nm to greater than 6 nm. SAW frequency transients occurring during the diffusion of small molecular species into polymer films have been used to obtain diffusion coefficients from 10/sup {minus}9/ to 10/sup {minus}15/ cm^2/sec. 26 refs., 5 figs.

22602 (SAND—88-2494C) Summary of aging effects on 25-year old nylon parachutes. Tadios, E.L. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 14p. (CONF-8904118—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007083/JAW.

From 10. AIAA aerodynamic decelerator systems technical conference; Cocoa Beach, FL, USA (18 Apr 1989).

The results of structural evaluations on several parachute systems were examined to determine if any trends could be found that would indicate significant aging in the materials. All of the parachutes were more than 20 years old. Five 64 ft diameter parachutes were evaluated along with three 16.5 ft diameter ribbon parachutes and one 4 ft diameter guide surface parachute. Another group included six 48 ft diameter ribbon parachutes, two 4 ft diameter guide surface parachutes, and two 16.5 ft diameter extraction ribbon parachutes. The parachute systems used in the study were all fabricated from nylon materials. Data were obtained for several material properties such as tensile strength, air permeability and melting point. Military specifications were used as zero-time data base due to lack of raw material data. Generally speaking, after 25 years the material properties of the 64 ft parachutes were within specifications. The same generalization cannot be made for the 48 ft parachutes which were about 23 years old. The explanation for their differences may lie in their respective histories. 10 refs., 2 figs., 5 tabs.

22603 (SAND—88-3182C) The morphology of freeze-dried rubidium chloride powder. Panitz, J.K.G.; Voigt, J.A.; Greulich, F.A.; Carr, M.J.; Eatough, M.O. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 22p. (CONF-890426—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008195/JAW.

From Spring meeting of the Materials Research Society; San Diego, CA, USA (24 Apr 1989).

We have formed powders of a strongly ionic compound, RbCl by freeze-drying. Stock solutions varying from very low concentrations with 4 gm RbCl reagent dissolved in 100 cc water, to saturated solutions with 80 gm reagent in 100 cc water sprayed into isopentane at {minus}160{degree}C. The droplet size in the spray was varied from relatively large 4-mm diameter droplets to extremely small droplets in an aerosol spray. It was determined that both the concentration of the stock solution and the droplet size affect the average size and the size distribution of the primary particles formed and the way in which these primary particles are bonded together. Unlike the powders of many less ionic compounds that are produced by freeze-drying, the primary particles in these RbCl powders are crystalline rather than amorphous. Analysis with an x-ray diffractometer with a cold stage indicates that crystallization occurs during the freezing cycle rather than during the sublimation period of the freeze-drying process. 11 refs., 8 figs.

22604 (SERI/TP—254-3454) Measurement uncertainty of adsorption testing of desiccant materials. Bingham, C.E.; Pesaran, A.A. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1988. Contract AC02-83CH10093. 8p. (CONF-890436—8). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000841/JAW.

From American Society of Mechanical Engineers solar energy conference; San Diego, CA, USA (2 Apr 1989).

The technique of measurement uncertainty analysis as described in the current ANSI/ASME standard is applied to the testing of desiccant materials in SERI's Sorption Test Facility. This paper estimates the elemental precision and systematic errors in these tests and propagates them separately to obtain the resulting uncertainty of the test parameters, including relative humidity (+-.03) and sorption capacity (+-.002 g/g). Errors generated by instrument calibration, data acquisition, and data reduction are considered. Measurement parameters that would improve the uncertainty of the results are identified. Using the uncertainty in the moisture capacity of a desiccant, the design engineer can estimate the uncertainty in performance of a dehumidifier for desiccant cooling systems with confidence. 6 refs., 2 figs., 8 tabs.

22605 (UCRL—99846) Resorcinol-formaldehyde aerogels and their carbonized derivatives. Pekala, R.W.; Kong, F.M. (Lawrence Livermore National Lab., CA (USA)). 24 Oct 1988. Contract W-7405-ENG-48. 15p. (CONF-890401—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89002274/JAW.

From 197. national meeting of the American Chemical Society; Dallas, TX, USA (9 Apr 1989).

Organic aerogels are produced from the supercritical drying of resorcinol-formaldehyde gels. The aerogels have continuous porosity with cell/pore sizes <1000 {angstrom}. Their morphology consists of interconnected colloidal-like particles with diameters of 30--100 {angstrom}. The microstructure is retained even after pyrolysis to 1075{degree}C. The particle size, cell size, surface area, and density of both the resorcinol-formaldehyde aerogels and their carbonized derivatives are largely determined by the catalyst concentration used in the gel synthesis. A major benefit of carbonization is the superior mechanical properties of the resultant aerogels. 10 refs., 6 figs.

22606 (UCRL—99995) Low-density foams from macroporous epoxy gels. LeMay, J.D. (Lawrence Livermore National Lab., CA (USA)). 7 Nov 1988. Contract W-7405-ENG-48. 11p. (CONF-890483—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004042/JAW.

From American Chemical Society Polymeric Materials Division meeting; Dallas, TX, USA (9 Apr 1989).

A technology for making low-density, microcellular epoxy foams is described. The foam precursor is a heterogeneous (two-phase), macroporous gel made by homopolyerizing an epoxy novolac oligomer in an inert diluent. Dry foam is recovered from the gel with little shrinkage by exchanging the diluent with liquefied carbon dioxide then processing at supercritical conditions. Foams have been made with densities ranging from 0.034 to 0.150 g/cc. SEM micrographs of the dry foams reveal a highly porous, ramified morphology that is self-similar over at least 1-2 orders of magnification. The structure contains open cells with diameters ranging from 0.1 to several microns. The foams are characterized by high BET surface areas (100- 300 m^2/g). 8 refs., 5 figs.

22607 **Microstructural studies of epitaxial Ge films grown on [100] GaAs by laser photochemical vapor deposition.** Kiely, C.J.; Tavitian, V.; Eden, J.G. (University of Illinois, Urbana, Illinois 61801). *Journal of Applied Physics;* **65**: No. 10, 3883-3895(15 May 1989).

Ge films grown on [100] GaAs by laser photochemical vapor deposition (LPVD) in parallel geometry at temperatures (T/sub s/) ranging from {similar←to}240 to 415 °C have been examined by transmission electron microscopy. For 285 ≦T/sub s/ approx. <330 °C, a thin (250--700 A) epitaxial film is grown initially but a switch to amorphous material is subsequently observed. At higher substrate temperatures (T/sub s/ approx. >400 °C), thicker (approx. >800 A) epitaxial Ge films are grown before the transition to polycrystalline material takes place. In the absence of external 193-nm laser radiation (i.e., growing by conventional low-pressure chemical vapor deposition), the Ge films are completely amorphous (285 ≦T/sub s/≦330 °C) or heavily defected polycrystalline (T/sub s/{similar←to}400 °C). The >100 °C temperature reduction for the growth of epi Ge films made possible by LPVD is attributed to the direct production of a species (GeH_3) by the laser which is collisionally converted to Ge_2H_6 en route to the substrate. Upon reaching the [100] GaAs surface, the digermane is pyrolyzed. Experiments with [100] substrates tilted 3° toward [110] yielded thinner ({similar←to}120 A), but smooth, epitaxial films which is attributed to the higher density of available nucleation sites. Films grown at 280--330 °C on [111] oriented GaAs were completely amorphous which appears to arise from reduced adatom mobilities on [111] surfaces.

22608 **Nature of interfaces and oxidation processes in Ge^+-implanted Si.** Srivatsa, A.R.; Sharan, S.; Holland, O.W.; Narayan, J. (Department of Materials Science and Engineering, North Carolina State University, Raleigh, North Carolina 27695-7916). *Journal of Applied Physics;* **65**: No. 10, 4028-4032(15 May 1989).

We have studied the nature of the interfaces between silicon dioxide and germanium-rich layer (SiO_2/Ge/sub x/Si/sub 1-//sub x/) in Ge^+-ion implanted and oxidized Si (100) samples. A series of implants were used to study the interfacial roughness as a function of implant dose. Oxidations were carried out at temperatures both above and below the viscous flow point of silicon dioxide (SiO_2). In each case, the SiO_2/Ge/sub x/Si/sub 1-//sub x/ interface was found to be sharper on an atomic scale compared to the oxide/silicon (SiO_2/Si) interface in virgin Si formed after similar oxidation treatments. An enhancement in oxidation was found for the implanted samples over the virgin silicon samples. This enhancement was greater for oxidation carried out at 900 °C for 30 min compared to that at 1000 °C for 20 min. At the higher implant doses, predominantly 60° misfit dislocations were observed at the Ge/sub x/Si/sub 1-//sub x//Si interface. The mechanism of oxidation leading to these phenomena is discussed in detail.

22609 **Transmission electron microscopy of strained In/sub y/Ga_1/sub -//sub y/As/GaAs multiquantum wells: The generation of misfit dislocations.** Chang, K.H.; Bhattacharya, P.K.; Gibala, R. (Department of Materials Science and Engineering, The University of Michigan, Ann Arbor, Michigan 48109). *Journal of Applied Physics;* **65**: No. 9, 3391-3394(1 May 1989).

We have investigated the generation and propagation of misfit dislocations in strained In/sub y/Ga/sub 1-//sub y/As/GaAs multiquantum wells grown by molecular-beam epitaxy, with cross-sectional transmission electron microscopy. The samples are of excellent optical quality, with multiquantum wells having well widths of 100 A, being characterized by excitonic linewidths and Stokes shifts of 1.5--2.5 and 1--2 meV, respectively. We have examined the growth of 2-μm-thick multiquantum-well samples grown either directly on GaAs, or with an intermediate composition buffer layer, and for the cases of small (y = 0.07) and large (y = 0.16) misfits. It is seen that for the case of quantum wells with small misfit, grown directly on GaAs, metastable growth can be achieved. This is confirmed by low-temperature absorption measurements and from transmission electron microscopy experiments performed both before and after post-growth thermal annealing. In the case of quantum wells with large misfits directly grown on GaAs, dislocations are generated within the first few periods, and high optical quality is retained in the subsequent free-standing quantum wells. In the case of quantum wells grown with an intermediate composition In/sub x/Ga/sub 1-//sub x/As buffer layer, dislocations are generated at the buffer-GaAs interface, and the freestanding multiquantum well is again of very high quality.

22610 **Ion mixing of near-noble monosilicides with Si substrates.** Hong, Q.Z.; Hung, L.S.; Mayer, J.W. (Department of Materials Science and Engineering, Cornell University, Ithaca, New York 14850). *Journal of Applied Physics;* **65**: No. 9, 3395-3399(1 May 1989).

Xe ion irradiation of NiSi, PdSi, and PtSi on Si was performed at various substrate temperatures. The phase formation and mixing behavior of the three monosilicides with their Si substrates are quite different. For NiSi, $NiSi_2$ was formed on amorphous Si substrates at 350 °C, while NiSi remained stable on crystalline Si substrates even at 400 °C. PtSi reacted with Si to form a metastable Pt_4Si_9 phase, which decomposed back to PtSi and Si by successive irradiation at higher temperatures. The decomposition of the metastable Pt_4Si_9 was easier on crystalline Si substrates than on amorphous substrates. No mixing was observed for PdSi on Si in the temperature range of 35--400 °C. The ion mixing results were compared with those from thermal annealing. The importance of demixing of a thermally stable system was explored.

22611 **Shallow melting of thin heavily doped silicon layers by pulsed CO_2 laser irradiation.** James, R.B.; Christie, W.H. (Theoretical Division, Sandia National Laboratories, Livermore, California 94550). *Journal of Applied Physics;* **65**: No. 9, 3655-3661(1 May 1989).

We show that an extremely shallow (approx. <800 A) melt depth can be easily obtained by irradiating a thin ({similar←to}200 A) heavily doped silicon layer with a CO_2 laser pulse. Since the absorption of the CO_2 laser pulse is dominated by free-carrier transitions, the beam heating occurs primarily in the thin degenerately doped film at the sample surface, and there is little energy deposited in the underlying lightly doped substrate. For CO_2 pulse-energy densities exceeding a threshold value of about 5 J/cm^2, surface melting occurs and the reflectivity of the incident laser pulse increases abruptly to about 90%. This large increase in the reflectivity acts like a switch to reflect almost all of the energy in the remainder of the CO_2 laser pulse, thereby greatly reducing the amount of energy available to drive the melt front to deeper depths in the material. This is in contrast to the energy deposition of a laser pulse that has a photon energy exceeding the band gap, in which case the penetration depth of the incident radiation is only weakly affected by the free-carrier density. Transmission electron microscopy shows no extended defects in the near-surface region after CO_2 laser irradiation, and van der Pauw electrical measurements verify that 100% of the implanted arsenic dopant is electrically active. Calculated values for the melt depth versus incident pulse-energy density (E/sub L/) indicate that there exists a window where the maximum melt-front penetration increases slowly with increasing E/sub L/ and has a value of less than a few hundred angstroms.

22612 **Small-angle x-ray scattering study of the fractal morphology of porous silicas.** Schmidt, P.W.; Hoehr, A.; Neumann, H.; Kaiser, H.; Avnir, D.; Lin, J.S. (Physics Department, University of Missouri, Columbia, Missouri 65211). *Journal of Chemical Physics;* **90**: No. 9, 5016-5023(1 May 1989).

22600 **(RAL—88-095) Neutron spectroscopy study of magnetic excitations in uranium oxysulfide.** Amoretti, G.; Blaise, A.; Caciuffo, R.; Fournier, J.M.; Larroque, J.; Osborn, R. (Palermo Univ. (Italy). Ist. di Fisica; CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale; Ancona Univ. (Italy). Dipt. di Scienze dei Materiali e della Terra; Universite Scientifique et Medicale, Grenoble (France); CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). (Rutherford Appleton Lab., Chilton (UK)). Dec 1988. 26p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706126/JAW.

A neutron spectroscopy experiment has been performed to observe the position of the crystal field levels in both the paramagnetic and antiferromagnetic phases of UOS (uranium oxysulfide). The J = 4 ground manifold undergoes an overall splitting of about 100 meV in agreement with the predictions of a crystal field model used to analyze specific heat data. Above T/sub N/, two main peaks are observed at 74 and 82 meV with a shoulder at about 87 meV. Below T/sub N/ there is a redistribution of intensity together with a shift of the peak positions to 76, 84 and 92 meV at T = 30K. The experimental observations are interpreted in the framework of a refined crystal field model.

22601 **(SAND—88-0943C) Monitoring thin film properties with surface acoustic wave devices: Diffusion, surface area and pore size distribution.** Frye, G.C.; Martin, S.J.; Ricco, A.J.; Brinker, C.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 21p. (CONF-880912—28). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009379/JAW.

From 196. American Chemical Society national meeting; Los Angeles, CA, USA (25 Sep 1988).

The ability of surface acoustic wave (SAW) devices to monitor adsorption of N_2 onto the surfaces of porous films and diffusion of species into polymer films has been demonstrated. Calculations based on the N_2 adsorption isotherms illustrate how sol-gel solution chemistry can be used to tailor the surface area and pore size distribution of thin films. BET surface areas from unity to over 30 cm^2/cm^2 of film have been obtained with median pore diameters from less than 0.4 nm to greater than 6 nm. SAW frequency transients occurring during the diffusion of small molecular species into polymer films have been used to obtain diffusion coefficients from 10/sup {minus}9/ to 10/sup {minus}15/ cm^2/sec. 26 refs., 5 figs.

22602 **(SAND—88-2494C) Summary of aging effects on 25-year old nylon parachutes.** Tadios, E.L. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 14p. (CONF-8904118—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007083/JAW.

From 10. AIAA aerodynamic decelerator systems technical conference; Cocoa Beach, FL, USA (18 Apr 1989).

The results of structural evaluations on several parachute systems were examined to determine if any trends could be found that would indicate significant aging in the materials. All of the parachutes were more than 20 years old. Five 64 ft diameter parachutes were evaluated along with three 16.5 ft diameter ribbon parachutes and one 4 ft diameter guide surface parachute. Another group included six 48 ft diameter ribbon parachutes, two 4 ft diameter guide surface parachutes, and two 16.5 ft diameter extraction ribbon parachutes. The parachute systems used in the study were all fabricated from nylon materials. Data were obtained for several material properties such as tensile strength, air permeability and melting point. Military specifications were used as zero-time data base due to lack of raw material data. Generally speaking, after 25 years the material properties of the 64 ft parachutes were within specifications. The same generalization cannot be made for the 48 ft parachutes which were about 23 years old. The explanation for their differences may lie in their respective histories. 10 refs., 2 figs., 5 tabs.

22603 **(SAND—88-3182C) The morphology of freeze-dried rubidium chloride powder.** Panitz, J.K.G.; Voigt, J.A.; Greulich, F.A.; Carr, M.J.; Eatough, M.O. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 22p. (CONF-890426—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008195/JAW.

From Spring meeting of the Materials Research Society; San Diego, CA, USA (24 Apr 1989).

We have formed powders of a strongly ionic compound, RbCl by freeze-drying. Stock solutions varying from very low concentrations with 4 gm RbCl reagent dissolved in 100 cc water, to saturated solutions with 80 gm reagent in 100 cc water sprayed into isopentane at {minus}160{degree}C. The droplet size in the spray was varied from relatively large 4-mm diameter droplets to extremely small droplets in an aerosol spray. It was determined that both the concentration of the stock solution and the droplet size affect the average size and the size distribution of the primary particles formed and the way in which these primary particles are bonded together. Unlike the powders of many less ionic compounds that are produced by freeze-drying, the primary particles in these RbCl powders are crystalline rather than amorphous. Analysis with an x-ray diffractometer with a cold stage indicates that crystallization occurs during the freezing cycle rather than during the sublimation period of the freeze-drying process. 11 refs., 8 figs.

22604 **(SERI/TP—254-3454) Measurement uncertainty of adsorption testing of desiccant materials.** Bingham, C.E.; Pesaran, A.A. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1988. Contract AC02-83CH10093. 8p. (CONF-890436—8). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000841/JAW.

From American Society of Mechanical Engineers solar energy conference; San Diego, CA, USA (2 Apr 1989).

The technique of measurement uncertainty analysis as described in the current ANSI/ASME standard is applied to the testing of desiccant materials in SERI's Sorption Test Facility. This paper estimates the elemental precision and systematic errors in these tests and propagates them separately to obtain the resulting uncertainty of the test parameters, including relative humidity (+-.03) and sorption capacity (+-.002 g/g). Errors generated by instrument calibration, data acquisition, and data reduction are considered. Measurement parameters that would improve the uncertainty of the results are identified. Using the uncertainty in the moisture capacity of a desiccant, the design engineer can estimate the uncertainty in performance of a dehumidifier for desiccant cooling systems with confidence. 6 refs., 2 figs., 8 tabs.

22605 **(UCRL—99846) Resorcinol-formaldehyde aerogels and their carbonized derivatives.** Pekala, R.W.; Kong, F.M. (Lawrence Livermore National Lab., CA (USA)). 24 Oct 1988. Contract W-7405-ENG-48. 15p. (CONF-890401—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89002274/JAW.

From 197. national meeting of the American Chemical Society; Dallas, TX, USA (9 Apr 1989).

Organic aerogels are produced from the supercritical drying of resorcinol-formaldehyde gels. The aerogels have continuous porosity with cell/pore sizes <1000 {angstrom}. Their morphology consists of interconnected colloidal-like particles with diameters of 30--100 {angstrom}. The microstructure is retained even after pyrolysis to 1075{degree}C. The particle size, cell size, surface area, and density of both the resorcinol-formaldehyde aerogels and their carbonized derivatives are largely determined by the catalyst concentration used in the gel synthesis. A major benefit of carbonization is the superior mechanical properties of the resultant aerogels. 10 refs., 6 figs.

22606 **(UCRL—99995) Low-density foams from macroporous epoxy gels.** LeMay, J.D. (Lawrence Livermore National Lab., CA (USA)). 7 Nov 1988. Contract W-7405-ENG-48. 11p. (CONF-890483—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004042/JAW.

From American Chemical Society Polymeric Materials Division meeting; Dallas, TX, USA (9 Apr 1989).

A technology for making low-density, microcellular epoxy foams is described. The foam precursor is a heterogeneous (two-phase), macroporous gel made by homopolyerizing an epoxy novolac oligomer in an inert diluent. Dry foam is recovered from the gel with little shrinkage by exchanging the diluent with liquefied carbon dioxide then processing at supercritical conditions. Foams have been made with densities ranging from 0.034 to 0.150 g/cc. SEM micrographs of the dry foams reveal a highly porous, ramified morphology that is self-similar over at least 1-2 orders of magnification. The structure contains open cells with diameters ranging from 0.1 to several microns. The foams are characterized by high BET surface areas (100- 300 m^2/g). 8 refs., 5 figs.

22607 **Microstructural studies of epitaxial Ge films grown on [100] GaAs by laser photochemical vapor deposition.** Kiely, C.J.; Tavitian, V.; Eden, J.G. (University of Illinois, Urbana, Illinois 61801). *Journal of Applied Physics;* **65**: No. 10, 3883-3895(15 May 1989).

Ge films grown on [100] GaAs by laser photochemical vapor deposition (LPVD) in parallel geometry at temperatures (T/sub s/) ranging from {similar←to}240 to 415 °C have been examined by transmission electron microscopy. For 285 ≦T/sub s/approx. <330 °C, a thin (250--700 A) epitaxial film is grown initially but a switch to amorphous material is subsequently observed. At higher substrate temperatures (T/sub s/ approx. >400 °C), thicker (approx. >800 A) epitaxial Ge films are grown before the transition to polycrystalline material takes place. In the absence of external 193-nm laser radiation (i.e., growing by conventional low-pressure chemical vapor deposition), the Ge films are completely amorphous (285 ≦T/sub s/≦330 °C) or heavily defected polycrystalline (T/sub s/{similar←to}400 °C). The >100 °C temperature reduction for the growth of epi Ge films made possible by LPVD is attributed to the direct production of a species (GeH_3) by the laser which is collisionally converted to Ge_2H_6 en route to the substrate. Upon reaching the [100] GaAs surface, the digermane is pyrolyzed. Experiments with [100] substrates tilted 3° toward [110] yielded thinner ({similar←to}120 A), but smooth, epitaxial films which is attributed to the higher density of available nucleation sites. Films grown at 280--330 °C on [111] oriented GaAs were completely amorphous which appears to arise from reduced adatom mobilities on [111] surfaces.

22608 **Nature of interfaces and oxidation processes in Ge^+-implanted Si.** Srivatsa, A.R.; Sharan, S.; Holland, O.W.; Narayan, J. (Department of Materials Science and Engineering, North Carolina State University, Raleigh, North Carolina 27695-7916). *Journal of Applied Physics;* **65**: No. 10, 4028-4032(15 May 1989).

We have studied the nature of the interfaces between silicon dioxide and germanium-rich layer (SiO_2/Ge/sub x/Si/sub 1-//sub x/) in Ge^+-ion implanted and oxidized Si (100) samples. A series of implants were used to study the interfacial roughness as a function of implant dose. Oxidations were carried out at temperatures both above and below the viscous flow point of silicon dioxide (SiO_2). In each case, the SiO_2/Ge/sub x/Si/sub 1-//sub x/ interface was found to be sharper on an atomic scale compared to the oxide/silicon (SiO_2/Si) interface in virgin Si formed after similar oxidation treatments. An enhancement in oxidation was found for the implanted samples over the virgin silicon samples. This enhancement was greater for oxidation carried out at 900 °C for 30 min compared to that at 1000 °C for 20 min. At the higher implant doses, predominantly 60° misfit dislocations were observed at the Ge/sub x/Si/sub 1-//sub x//Si interface. The mechanism of oxidation leading to these phenomena is discussed in detail.

22609 **Transmission electron microscopy of strained In/sub y/Ga_1/sub -//sub y/As/GaAs multiquantum wells: The generation of misfit dislocations.** Chang, K.H.; Bhattacharya, P.K.; Gibala, R. (Department of Materials Science and Engineering, The University of Michigan, Ann Arbor, Michigan 48109). *Journal of Applied Physics;* **65**: No. 9, 3391-3394(1 May 1989).

We have investigated the generation and propagation of misfit dislocations in strained In/sub y/Ga/sub 1-//sub y/As/GaAs multiquantum wells grown by molecular-beam epitaxy, with cross-sectional transmission electron microscopy. The samples are of excellent optical quality, with multiquantum wells having well widths of 100 A, being characterized by excitonic linewidths and Stokes shifts of 1.5--2.5 and 1--2 meV, respectively. We have examined the growth of 2-μm-thick multiquantum-well samples grown either directly on GaAs, or with an intermediate composition buffer layer, and for the cases of small (y = 0.07) and large (y = 0.16) misfits. It is seen that for the case of quantum wells with small misfit, grown directly on GaAs, metastable growth can be achieved. This is confirmed by low-temperature absorption measurements and from transmission electron microscopy experiments performed both before and after post-growth thermal annealing. In the case of quantum wells with large misfits directly grown on GaAs, dislocations are generated within the first few periods, and high optical quality is retained in the subsequent free-standing quantum wells. In the case of quantum wells grown with an intermediate composition In/sub x/Ga/sub 1-//sub x/As buffer layer, dislocations are generated at the buffer-GaAs interface, and the freestanding multiquantum well is again of very high quality.

22610 **Ion mixing of near-noble monosilicides with Si substrates.** Hong, Q.Z.; Hung, L.S.; Mayer, J.W. (Department of Materials Science and Engineering, Cornell University, Ithaca, New York 14850). *Journal of Applied Physics;* **65**: No. 9, 3395-3399(1 May 1989).

Xe ion irradiation of NiSi, PdSi, and PtSi on Si was performed at various substrate temperatures. The phase formation and mixing behavior of the three monosilicides with their Si substrates are quite different. For NiSi, $NiSi_2$ was formed on amorphous Si substrates at 350 °C, while NiSi remained stable on crystalline Si substrates even at 400 °C. PtSi reacted with Si to form a metastable Pt_4Si_9 phase, which decomposed back to PtSi and Si by successive irradiation at higher temperatures. The decomposition of the metastable Pt_4Si_9 was easier on crystalline Si substrates than on amorphous substrates. No mixing was observed for PdSi on Si in the temperature range of 35--400 °C. The ion mixing results were compared with those from thermal annealing. The importance of demixing of a thermally stable system was explored.

22611 **Shallow melting of thin heavily doped silicon layers by pulsed CO_2 laser irradiation.** James, R.B.; Christie, W.H. (Theoretical Division, Sandia National Laboratories, Livermore, California 94550). *Journal of Applied Physics;* **65**: No. 9, 3655-3661(1 May 1989).

We show that an extremely shallow (approx. <800 A) melt depth can be easily obtained by irradiating a thin ({similar←to}200 A) heavily doped silicon layer with a CO_2 laser pulse. Since the absorption of the CO_2 laser pulse is dominated by free-carrier transitions, the beam heating occurs primarily in the thin degenerately doped film at the sample surface, and there is little energy deposited in the underlying lightly doped substrate. For CO_2 pulse-energy densities exceeding a threshold value of about 5 J/cm^2, surface melting occurs and the reflectivity of the incident laser pulse increases abruptly to about 90%. This large increase in the reflectivity acts like a switch to reflect almost all of the energy in the remainder of the CO_2 laser pulse, thereby greatly reducing the amount of energy available to drive the melt front to deeper depths in the material. This is in contrast to the energy deposition of a laser pulse that has a photon energy exceeding the band gap, in which case the penetration depth of the incident radiation is only weakly affected by the free-carrier density. Transmission electron microscopy shows no extended defects in the near-surface region after CO_2 laser irradiation, and van der Pauw electrical measurements verify that 100% of the implanted arsenic dopant is electrically active. Calculated values for the melt depth versus incident pulse-energy density (E/sub L/) indicate that there exists a window where the maximum melt-front penetration increases slowly with increasing E/sub L/ and has a value of less than a few hundred angstroms.

22612 **Small-angle x-ray scattering study of the fractal morphology of porous silicas.** Schmidt, P.W.; Hoehr, A.; Neumann, H.; Kaiser, H.; Avnir, D.; Lin, J.S. (Physics Department, University of Missouri, Columbia, Missouri 65211). *Journal of Chemical Physics;* **90**: No. 9, 5016-5023(1 May 1989).

Small-angle x-ray and neutron scattering measurements have shown that on a length scale smaller than the average pore diameter but larger than the diameters of atoms or small molecules, the pore surfaces in four commercial porous silica gels with average pore diameters ranging from approximately 200 to 2500 A are fractal and have a fractal dimension D = 2.15 +- 0.10. When these gels were manufactured, the nonequilibrium micropore structure was relaxed by thermal methods. The scattering data indicate that in the gels with average pore diameters of about 200 and 500 A, and perhaps also in the two gels with larger average pore diameters, the relaxation process leads to a pore structure nearly identical in form but on a larger scale than the structure in a gel with an average pore diameter of 60 A that was the material from which the other four gels were produced.

22613 **Static and dynamic properties of solid CO_2 at various temperatures and pressures.** Etters, R.D.; Kuchta, B. (Physics Department, Colorado State University, Fort Collins, Colorado 80523). *Journal of Chemical Physics;* **90**: No. 8, 4537-4541(15 Apr 1989).

A constant pressure Monte Carlo formalism, lattice dynamics, and classical perturbation theory are used to calculate the thermal expansion, pressure--volume relation at room temperature, the temperature dependence of the zone center libron frequencies, and the pressure dependence of the three vibron modes of vibration, in solid CO_2 at pressures $0 \leqq p \leqq 16$ GPa and temperatures $0 \leqq T \leqq 300$ K. The agreement with experiment is good. At room temperature the observed Pa3 phase is predicted for $P \leqq 11$ GPa, above which a transition occurs into an orthorhombic Cmca structure, with a volume change upon transition of $\Delta V = 0.4$ cm^3 /mol. Calculated physical quantities in this phase are consistent with experiment.

22614 **Effect of impurities on the charge-density-wave dynamics in Ta/sub 1-//sub x/Nb/sub x/S_3 alloys.** Reagor, D.; Gruener, G. (Los Alamos National Laboratory, Los Alamos, New Mexico 87544). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 11, 7626-7640(15 Apr 1989).

We report conductivity and dielectric-constant measurements on a series of orthorhombic Ta/sub 1-//sub x/Nb/sub x/S_3 alloys, with nominal concentrations between 0% and 0.3%, in the dc to 100-GHz frequency range. The Peierls transition observed at T/sub P/ = 220 K in the pure specimens is smeared and suppressed in the alloys. The pinned--charge-density-wave mode, which occurs at the pinning frequency of $\omega_0/2\pi$ {similar←to} 5 GHz in the nominally pure specimen, increases with increasing dopant concentration at all temperatures. We analyzed the pinned mode in terms of a harmonic-oscillator response and found that the effective mass m/sup */ and damping constant 1/tau are independent of the impurity concentration. We also discuss the temperature dependence of ω_0 and tau and compare with the available theoretical descriptions of charge-density-wave dynamics.

22615 **Ab initio calculation of pressure coefficients of band gaps of silicon: Comparison of the local-density approximation and quasiparticle results.** Zhu, X.; Fahy, S.; Louie, S.G. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 11, 7840-7847(15 Apr 1989).

The pressure coefficients of band gaps of silicon are calculated with use of a first-principles quasiparticle approach. For comparison, the same quantities are also computed within the Hohenberg-Kohn-Sham local-density approximation (LDA). In both cases, the calculations were performed for volumes corresponding to pressures between 0 and 150 kbar using ab initio norm-conserving pseudopotentials. The electron self-energy in the quasiparticle calculation is obtained with use of a first-order expansion in the dressed Green's function G and the screened Coulomb interaction W with local fields. The quasiparticle results show a linear dependence of changes in the band gaps on lattice constant, while the dependence on pressure deviates from linearity at high pressure. The LDA band-gap pressure coefficients, obtained using three commonly used exchange-correlation potential forms, are shown to be very close to the quasiparticle values for the whole range of crystal volumes we considered. At some of the volumes considered, the LDA band gaps are negative. Both sets of pressure-coefficient results are in very good agreement with available experimental values for Si.

22616 **Silicon (111) 2 x 1 surface states: K-edge transitions and surface-selective L/sub 2,3/VV Auger line shape.** Woicik, J.C.; Pate, B.B.; Pianetta, P. (Stanford Synchrotron Radiation Laboratory, Stanford University, P.O. Box 4349, Stanford, California 94305). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 12, 8593-8604(15 Apr 1989).

Transitions to unoccupied Si(111) 2 x 1 surface states have been observed at the silicon 1s absorption edge. The surface features are distinguished from bulk absorption by taking the difference between the absorption measured by monitoring the surface-sensitive LVV Auger decay (88 eV kinetic energy) and the bulk-sensitive KLL Auger decay (1610 eV kinetic energy). The difference curve reveals a surface peak which is centered 0.3 +- 0.15 eV above the conduction-band minimum and which disappears upon exposure of the clean surface to atomic hydrogen. By tuning the photon energy to the energy of this surface peak and selectively exciting the surface, we have extracted the contribution of the 2 x 1 surface to the total Si L/sub 2,3/VV Auger line shape. We find that the surface contribution to the Si L/sub 2,3/VV Auger line shape lies 0.5 +- 0.1 eV kinetic energy above the total contribution due to the presence of the Si(111) 2 x 1 occupied dangling-bond surface states, and the intensity of the bulk plasmon loss at 70 eV kinetic energy is suppressed due to the presence of the 2 x 1 π-bonded surface. Formation of the Si(111)-(1 x 1)H surface produces changes in the Auger spectra which are consistent with the removal of the occupied dangling-bond surface states from the band gap, the introduction of a Si-H bonding level 6.5 eV below the valence-band maximum, and the enhancement of the bulk-plasmon loss. We also find that the intensity of the high-energy Auger satellite at 103 eV kinetic energy is sensitive to the excitation photon energy within the vicinity of the silicon K edge and present a viable mechanism which accounts for this phenomenon.

22617 **Phonon dispersion and lattice dynamics of $KTaO_3$ from 4 to 1220 K.** Perry, C.H.; Currat, R.; Buhay, H.; Migoni, R.M.; Stirling, W.G.; Axe, J.D. (Department of Physics, Northeastern University, Boston, Massachusetts 02115). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 12, 8666-8676(15 Apr 1989).

A complete set of transverse and longitudinal phonon branches in each of the three principal directions (<100>, <110>, and <111>) and polarizations have been measured up to 60 meV in the cubic perovskite $KTaO_3$. Results were obtained at 296 K and at several other temperatures between 4 and 1220 K. The data have been analyzed in terms of a shell model which includes a fourth-order core-shell interaction at the O/sup 2-/ ion. Within the self-consistent mean-field approximation a very accurate description of the lattice dynamics over the whole temperature range is obtained. It is shown that the nonlinear polarizability of O/sup 2-/ along the Ta-O-Ta chains is primarily responsible for most of the phonon shifts, particularly of the ferroelectric soft mode, and for the strong second-order Raman effect.

22618 **Photoconductivity measurements of x-ray-absorption spectra of tetramethyl tin in 2,2,4-trimethylpentane near the Sn K edge.** Sham, T.K.; Holroyd, R.A. (Department of Chemistry, The University of Western Ontario, London, Ontario, Canada N6Achemical bond5B7). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 12, 8257-8262(15 Apr 1989).

X-ray-induced photoconductivity is used to record the x-ray-absorption spectra of solutions of tetramethyl tin, $(CH_3)_4Sn$, in 2,2,4-trimethylpentane near the Sn K edge (29.2 keV). It is found that at low concentrations the edge jump observed in the conductivity (ionization yield) spectrum is similar to that of the normal absorption spectrum, while at higher concentrations the conductivity edge jump is inverted, an observation consistent with previous findings. It is also observed for the first time that a changeover from normal to an inverse edge jump takes place at a narrow region of concentrations. An additivity model of ionization yields is introduced. It is shown that this model can be used to explain the results and to predict the correct concentration where the inversion of the absorption edge occurs.

22619 **Heteroepitaxy of GaAs on Si and Ge using alternating, low-energy ion beams.** Haynes, T.E.; Zuhr, R.A.; Pennycook, S.J.; Appleton, B.R. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Applied Physics Letters;* **54**: No. 15, 1439-1441(10 Apr 1989).

Crystalline GaAs films have been grown epitaxially on silicon and germanium substrates at 400 °C by direct deposition of alternating ^{69}Ga and ^{75}As layers from electromagnetically switched low-energy ion beams. Positive gallium and arsenic ions were extracted simultaneously from a single ion source and mass analyzed prior to deceleration to a controlled deposition energy of 30 or 40 eV. Atomic layers of gallium and arsenic were deposited alternately by switching the analyzing magnetic field repeatedly to select either the $^{69}Ga^+$ or $^{75}As^+$ species. The structure and composition of the resulting layers have been characterized by cross-section transmission electron microscopy and ion channeling/backscattering spectrometry. The best crystal quality was obtained for a GaAs layer deposited on Ge using a 30 eV beam. This layer gave an ion channeling minimum yield of ≈6%. These results demonstrate the feasibility of growing isotopically pure, single-crystal compound semiconductor layers at relatively low temperatures by deposition from alternating, fully ionized, low-energy beams.

22620 **Determination of the local Al concentration in Al/sub x/Ga/sub 1-//sub x/As-GaAs quantum well structures using the (200) diffraction intensity obtained with a 10 A electron beam.** Ou, H.; Tsen, S.Y.; Tsen, K.T.; Cowley, J.M.; Chyi, J.I.; Salvador, A.; Morkoc, H. (Department of Physics, Arizona State University, Tempe, Arizona 85287). *Applied Physics Letters;* **54**: No. 15, 1454-1456(10 Apr 1989).

A novel method for determining the local concentration of Al in the Al/sub x/Ga/sub 1-//sub x/As layer of Al/sub x/Ga/sub 1-//sub x/As-GaAs multiple quantum well structures is reported. By scanning a 10 A electron beam across the interface, the (200) dark-field scanning transmission electron microscopy (STEM) image shows the contrast of the Al/sub x/Ga/sub 1-//sub x/As-GaAs multilayer since the intensity of the (200) diffraction is sensitive to the Al concentration. The line scan intensity profile of the (200) diffraction, along a uniform specimen region of known thickness, shows the intensity variation of the (200) diffraction and reflects the local content of Al in each region. The simulation of the nanodiffraction patterns produces a chart of the (200) diffraction intensity versus the Al concentration for the determination of the local change of the Al concentration. A molecular beam epitaxy grown Al/sub x/Ga/sub 1-//sub x/As-GaAs specimen ($x = 0.57$ as determined from Raman spectroscopy) is tested and the dark-field STEM studies show two thin layers of $x = 0.46$ at the 1/3 and 2/3 height level within every Al/sub x/Ga/sub 1-//sub x/As layer.

22621 **Effect of boron on the deep donors (DX centers) in GaAs:Si.** Li, M.F.; Yu, P.Y.; Shan, W.; Hansen, W.; Weber, E.R. (Department of Physics, University of California, Berkeley, and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Applied Physics Letters;* **54**: No. 14, 1344-1346(3 Apr 1989).

We found that, when boron was introduced into GaAs:Si, the deep donors induced by pressure exceeding 20 kbar reported previously by M. Mizuta, M. Tachikawa, H. Kukimoto, and S. Minomura [J. Appl. Phys. 24, L143 (1985)] disappeared while new donor levels with reduced binding energies and capture barrier heights appeared. It is proposed that B atoms paired up with Si donor atoms and the resultant change in the short-range potential of the Si donor atoms depressed the capture barrier height of the pressure-induced deep donor.

22622 **Atomic correlations and intermediate-range order in molten and amorphous $GeSe_2$.** Vashishta, P.; Kalia, R.K.; Antonio, G.A.; Ebbsjoe, I. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **62**: No. 14, 1651-1654(3 Apr 1989).

Interatomic potentials consisting of two-body and three-body covalent forces are proposed for $GeSe_2$. Using these in molecular-dynamics simulations, the nature of intermediate-range order is investigated. All the features in S(q), including the first sharp diffraction peak (FSDP), are in agreement with experiments. The FSDP arises from Ge-Ge and Ge-Se correlations between 4--8 A, and the anomalous decrease in its height on cooling is due to frustration enhanced by increased density. The statistics of edge-sharing tetrahedra and rings are also discussed.

22623 **Ordered macromolecular structures in ferrofluid mixtures.** Hayter, J.B.; Pynn, R.; Charles, S.; Skjeltorp, A.T.; Trewhella, J.; Stubbs, G.; Timmins, P. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6031). *Physical Review Letters;* **62**: No. 14, 1667-1670(3 Apr 1989).

We have observed ordering of dilute dispersions of spherical and cylindrical macromolecules in magnetized ferrofluids. The order results from structural correlations between macromolecular and ferrofluid particles rather than from macroscopic magnetostatic effects. We have aligned elongated macromolecules by this technique and have obtained anisotropic neutron-diffraction patterns, which reflect the internal structure of the macromolecules. The method provides a tool for orienting suspended macromolecular assemblies which are not amenable to conventional alignment techniques.

22624 **Nucleation in the presence of long-range interactions.** Chandra, P. (Department of Physics, University of California at Santa Barbara, Santa Barbara, California 93106). *Physical Review [Section] A: General Physics;* **39**: No. 7, 3672-3681(1 Apr 1989).

We present a theory for nucleation at a first-order phase transition where the mediating forces are long range. We find that the long-range force induces cooperative nucleation and growth processes, and that this feedback mechanism produces a well-defined delay time with a sharp onset in the transformation to the stable phase. Closed-form expressions for the characteristic onset time and width of the transition are developed, in good agreement with numerical and existing experimental results.

22625 **Generation of axially phase-matched parametric four-wave and six-wave mixing in pure sodium vapor.** Moore, M.A.; Garrett, W.R.; Payne, M.G. (Chemical Physics Section, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee 37831-6378). *Physical Review [Section] A: General Physics;* **39**: No. 7, 3692-3695(1 Apr 1989).

Axially propagating phase-matched parametric four-wave and six-wave mixing in pure sodium vapor is an easily documented process that may be confused with other resonant processes such as amplified spontaneous emission or stimulated hyper-Raman emission. We demonstrate and characterize the process in sodium vapor under near-resonant two-photon excitations.

22626 **Polarized experimental and theoretical K-edge x-ray absorption studies of SO_4/sup 2-/, ClO_3^-, S_2O_3/sup 2-/, and S_2O_6/sup 2-/.** Tyson, T.A.; Roe, A.L.; Frank, P.; Hodgson, K.O.; Hedman, B. (Department of Chemistry, Stanford University, Stanford, California 94305). *Physical Review [Section] B: Condensed Matter;* **39**: No. 10, 6305-6315(1 Apr 1989).

The first studies of the polarized sulfur and chlorine x-ray K-edge absorption spectra of the oxyanions SO_4/sup 2-/ (sulfate), ClO_3^- (chlorate), S_2O_3/sup 2-/ (thiosulfate), and S_2O_6/sup 2-/ (dithionate) are presented. To provide a basis for the interpretation of the experimental measurements, extended continuum multiple-scattering Xα computations were carried out. This approach enabled us to identify features in the absorption spectra both by symmetry and final-state type (final bound states or final continuum states). For the thiosulfate anion (which has two nonequivalent sulfur atoms) it proved possible to determine which sulfur atom is responsible for each of a series of well-resolved features in the polarized spectra. In addition, generalizing from the case of the chlorate anion, molecules in which the absorbing atom is not completely surrounded by ligands ("open clusters") may have important contributions from the second shell of neighbors manifested as features in the continuum region of the spectrum.

22627 **Optical study and analysis of Pu/sup 4+/ in single crystals of $ZrSiO_4$.** Poirot, I.S.; Kot, W.K.; Edelstein, N.M.; Abraham, M.M.; Finch, C.B.; Boatner, L.A. (Department of Chemistry, University of California and Material and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **39**: No. 10, 6388-6394(1 Apr 1989).

The electronic structure of tetravalent plutonium incorporated as a dilute impurity in single crystals of the tetragonal host $ZrSiO_4$ has been studied using polarized optical spectroscopy. Fifty-three crystal-field levels were assigned and used to obtain a fit to a parametric Hamiltonian to within a rms deviation of 33 cm/sup -1/. The resulting crystal-field parameters were similar to those obtained for the U/sup 4+/:$ZrSiO_4$ and Np/sup 4+/:$ZrSiO_4$ systems. The parametric fit improves with increasing atomic number from U/sup 4+/ to Pu/sup 4+/, suggesting that the tetravalent actinides are more "lanthanidelike" as the atomic number increases.

22628 **Magnetic properties of Gd_2CuO_4 crystals.** Thompson, J.D.; Cheong, S.; Brown, S.E.; Fisk, Z.; Oseroff, S.B.; Tovar, M.; Vier, D.C.; Schultz, S. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **39**: No. 10, 6660-6666(1 Apr 1989).

Magnetic-susceptibility and magnetization measurements on single crystals of the CuO_2-planar compound Gd_2CuO_4 indicate copper moment ordering near 260 K, producing an internal field at the gadolinium site that induces substantial anisotropy in the magnetic response. Dilute substitutions for gadolinium and copper leave the essential physics unaffected. We suggest that copper ordering also occurs in Eu_2CuO_4 on the basis of substitutional studies but is not detected in other rare-earth-based compounds in this series. Rare-earth size appears to play an important role.

22629 **Harmonic magnons in Cd/sub 1-//sub x/Mn/sub x/Te and Zn/sub 1-//sub x/Mn/sub x/Te.** Giebultowicz, T.M.; Rhyne, J.J.; Ching, W.Y.; Huber, D.L.; Furdyna, J.K.; Lebech, B.; Galazka, R.R. (University of Notre Dame, Notre Dame, Indiana 46556). *Physical Review [Section] B: Condensed Matter;* **39**: No. 10, 6857-6870(1 Apr 1989).

Studies of spin dynamics in frustrated fcc antiferromagnets Cd/sub 1-//sub x/Mn/sub x/Te and Zn/sub 1-//sub x/Mn/sub x/Te are reported. Inelastic neutron scattering measurements carried out for single-crystal specimens with compositions Cd/sub 0.33/Mn/sub 0.67/Te, Zn/sub 0.35/Mn/sub 0.65/Te, and Zn/sub 0.59/Mn/sub 0.41/Te reveal that at low temperatures (T = 4.2--5 K) the magnetic excitation spectra of these systems are dominated by magnonlike modes despite the absence of long-range spin order. Theoretical modeling has been carried out by numerical techniques utilizing the formalism of conventional harmonic magnon theory. The results reproduce remarkably well the dispersion and the line-shape characteristics of the excitation modes seen in the experiments. As shown using another theoretical approach, the observed shift in the inelastic peak positions mirror the dispersion characteristics of spin waves in a perfect type-III antiferromagnetic structure. Fits of the numerically calculated line shapes to the experimental spectra yield information about the exchange parameters in the systems, which is especially difficult to obtain by other methods in the region of high Mn concentrations.

22630 **Flux creep in a polycrystalline Ba/sub 0.6/K/sub 0.4/BiO_3 superconductor.** McHenry, M.E.; Maley, M.P.; Kwei, G.H.; Thompson, J.D. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **39**: No. 10, 7339-7342(1 Apr 1989).

Magnetization curves have been measured as a function of temperature for a polycrystalline sample of Ba/sub 0.6/K/sub 0.4/BiO_3. These measurements reveal significant reversibility at modest fields for all temperatures studied. The irreversibility line (H/sup */,T/sup */) is determined for this material and shows that H/sup */ is less than 0.8 T at all temperatures. The logarithmic magnetic relaxation rate A = dM/d ln(t) has been studied for this material, as a function of both field and temperature. Analysis using the flux-creep model reveals the average pinning energy U_0 to be 0.08 +- 0.02 eV. This extremely small pinning energy is used to explain the small critical current, its strong dependence on field, and the significantly reversible behavior in this material.

22631 **Complete phase diagram of a charged colloidal system: A synchrotron x-ray scattering study.** Sirota, E.B.; Ou-Yang, H.D.; Sinha, S.K.; Chaikin, P.M.; Axe, J.D.; Fujii, Y. (Exxon Research and Engineering Co., Rt. 22 East, Annandale, New Jersey 08801). *Physical Review Letters;* **62**: No. 13, 1524-1527(27 Mar 1989).

High-resolution, small-angle, synchrotron x-ray-scattering techniques were used to determine the phase diagram, structure factor, and pair distribution function for a charged colloidal suspension from 6% to 30% volume fraction. The expected correlated liquid and fcc and bcc solid phases were observed along with a glass phase at high concentration with structure similar to metallic glasses. At high volume fractions the finite core size leads to substantial deviation from predictions resulting from a screened Coulomb interaction.

22632 **Tetracritical behavior of $CsMnBr_3$.** Gaulin, B.D.; Mason, T.E.; Collins, M.F.; Larese, J.Z. (Department of Physics, McMaster University, Hamilton, Ontario, Canada L8S 4M1). *Physical Review Letters;* **62**: No. 12, 1380-1383(20 Mar 1989).

We have used elastic neutron scattering to determine the magnetic phase diagram of $CsMnBr_3$, an XY antiferromagnet on a stacked triangular lattice. The application of a field along (100) splits the antiferromagnetic transition and results in an intermediate phase of spin-flop character. This phase is extremely narrow near the zero-field transition at T/sub N/ = 8.32 K which is shown to be a tetracritical point. This suggests that the unusual critical properties of the zero-field phase transition may be due to its tetracriticality as opposed to belonging to a new universality class.

22633 **Structural correlations and phonon density of states in $GeSe_2$: A molecular-dynamics study of molten and amorphous states.** Vashishta, P.; Kalia, R.K.; Ebbsjoe, I. (Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14853-2501). *Physical Review [Section] B: Condensed Matter;* **39**: No. 9, 6034-6047(15 Mar 1989).

With use of the molecular-dynamics technique, the structural and dynamical correlations in molten and vitreous $GeSe_2$ are investigated with an effective interionic potential which consists of Coulomb, charge-dipole, and steric interactions. It is found that the short-range order is dominated by Ge(Se/sub 1/2/)$_4$ tetrahedra and the Ge-Se, Se-Se, and Ge-Ge bond lengths are 2.35, 3.75, and 4.30 A, respectively. The static-structure factor exhibits the first sharp diffraction peak (FSDP)--a characteristic of the intermediate-range order in binary chalcogenide glasses. Partial pair-distribution functions and the corresponding static-structure factors indicate that Ge correlations are responsible for the FSDP, which is in agreement with differential-anomalous-scattering experiments. In the vitreous state, the FSDP displays an anomalous variation with temperature in that its height increases while the other peaks decrease in height upon heating. All the other peaks observed in the structural measurements are also found present in the calculated static-structure factor. The peak positions and their relative heights in the liquid and glass compare favorably with experiments. The calculated phonon density of states in the glass shows peaks at 8.0, 10.8, 26.4, 34.4, and 37.2 meV, which are in good agreement with the positions of the main peaks in inelastic-neutron-scattering experiments. In addition, we find a companion line of the symmetric breathing mode A_1 (26.4 meV) at 27.8 meV. Raman-scattering experiments also find the companion line to be {similar←to}1.5 meV higher than the A_1 mode.

22634 **Photon-energy-sensitive Si L/sub 2,3/VV Auger satellite.** Woicik, J.C.; Pianetta, P.; Sorensen, S.L.; Crasemann, B. (Stanford Synchrotron and Radiation Laboratory, Stanford Linear Accelerator Center, Stanford University, P.O. Box 4349, Stanford, California 94305). *Physical Review [Section] B: Condensed Matter;* **39**: No. 9, 6048-6051(15 Mar 1989).

The high-energy satellite structure which appears at 103 eV kinetic energy in the Si L/sub 2,3/VV Auger spectrum has been studied with synchrotron radiation. We find the intensity of the satellite to be sensitive to the photon energy in the vicinity of the Si K edge ($h\nu$ = 1840 eV). The results of an atomic Hartree-Fock ΔSCF (self-consistent field) calculation are presented which account for the energy position of the satellite, and an atomic model is described which accounts for its dependence on the excitation photon energy.

22635 **Kxp theory of semiconductor superlattice electronic structure in an applied magnetic field.** Wu, G.Y.; McGill, T.C.; Mailhiot, C.; Smith, D.L. (Thomas J. Watson, Sr. Laboratory of Applied Physics, California Institute of Technology, Pasadena, California 91125). *Physical Review [Section] B: Condensed Matter;* **39**: No. 9, 6060-6070(15 Mar 1989).

We present a kxp theory of semiconductor superlattices in an applied magnetic field. We consider superlattices with a [001] growth axis and the magnetic field along the growth axis. A single-basis set for the constituent materials is provided by a zone-center pseudopotential calculation with a reference Hamiltonian. The Γ/sub 15/ valence and Γ_1 conduction states are coupled with a spinor and treated explicitly. Nearby energy states are treated in Loewdin perturbation theory with the kxp operator and the difference between the material pseudopotential and the reference pseudopotential as the perturbation. The calculation is carried out consistently to first order in wave functions and second order in energies. Magnetic, exchange (in semimagnetic materials), spin-orbit, and strain (in strained-layer superlattices) interactions are included between the explicitly included states. When inversion-asymmetry and warping terms are dropped in the Hamiltonian, a Landau index becomes a good quantum number. Bloch and evanescent states are computed for a fixed Landau index in each material. Interface matching of the constituent-material bulk eigenfunctions is accomplished with use of results derived for the normal component of the current density operator. The Landau indices are not mixed by the interface matching. Superlattice translational symmetry is used to derive an eigenvalue equation for the superlattice wave vectors and eigenfunctions. The numerical implementation of the formal results is described and used to investigate a nonmagnetic superlattice Ga/sub 0.47/In/sub 0.53/As/Al_0.48In/sub 0.52/As and a semimagnetic superlattice Hg/sub 0.95/Mn/sub 0.05/Te/Cd/sub 0.78/Mn/sub 0.22/Te.

22636 **Electron emission due to positronium annihilation in solid Ar, Kr, and Xe.** Gullikson, E.M.; Mills A.P. Jr. (Accelerator and Fusion Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **39**: No. 9, 6121-6124(15 Mar 1989).

We present measurements of positron and electron emission by solid rare-gas surfaces implanted with low-energy positrons. The electron yield exhibits a 0.5-eV-wide peak at a positron energy just above the threshold for positronium (Ps) formation, but below the electron-hole--pair threshold. A similar peak in the fraction of the incident positrons annihilating in the sample leads us to conclude that (1) slow Ps has an anomalously short diffusion length possibly due to self-trapping, and (2) energetic electrons are liberated from Ps atoms following annihilation of the positrons with valence electrons. The energy spectrum of the emitted electrons should contain information about the internal Ps wave function in the solids.

22637 **Correlation between the activation enthalpy and Kohlrausch exponent for ionic conductivity in alkali aluminogermanate glasses.** Ngai, K.L.; Mundy, J.N.; Jain, H.; Kanert, O.; Balzer-Jollenbeck, G. (Naval Research Laboratory, Washington, D.C. 20375-5000). *Physical Review [Section] B: Condensed Matter;* **39**: No. 9, 6169-6179(15 Mar 1989).

The temperature and frequency dependence of electrical conductivity (σ/sub dc/) and the electrical modulus of sodium, rubidium, and Na-Rb mixed alkali germanate and aluminogermanate glasses have been determined for varying alkali concentrations, and [Al]/[Ge] and [Na]/[Rb] ratios. In a few glasses the spin-lattice relaxation times T_1 for /sup 23/Na have also been determined above room temperature. The frequency dependence of modulus is well fitted by the Kohlrausch ("stretched exponential" decay) function with exponent βequivalent1-n ($0<n<1$) where n, according to the "coupling model," is a measure of ion-ion correlations. The microscopic activation energy, determined either directly from the temperature dependence of T_1 or as the product of 1-n and the activation energy of σ/sub dc/, shows the best anticorrelation with n, as expected from the model.

22638 **Theory of time-resolved luminescence of bound excitons in semiconductor alloys.** Hjalmarson, H.P.; Myles, C.W. (Sandia National Laboratories, P.O. Box 5800, Albuquerque, New Mexico 87185-5800). *Physical Review [Section] B: Condensed Matter;* **39**: No. 9, 6216-6219(15 Mar 1989).

Time-resolved luminescence line shapes of bound excitons are predicted by solving a set of master equations in which the exciton transfer mechanism depends on impurity concentration, alloy composition, and lattice temperature. These predictions are used to interpret time-resolved optical experiments on N-doped GaAs/sub 1-//sub x/P/sub x/.

22639 **Negative spin-orbit bowing in semiconductor alloys.** Wei, S.; Zunger, A. (Solar Energy Research Institute, Golden, Colorado 80401). *Physical Review [Section] B: Condensed Matter;* **39**: No. 9, 6279-6282(15 Mar 1989).

Early measurements on many bulk III-V alloys showed that the spin-orbit splitting Δ_0 at the valence-band maximum (VBM) was universally reduced relative to the average value of the end-point constituents. This led to the assumption, guiding much of the subsequent data analysis, that such alloys universally mix some conduction-band s character into the VBM ("interband coupling"), suppressing Δ_0. Our self-consistent electronic-structure calculations for Ga(As,Sb) show very little s mixing in the VBM and an enhancement of Δ_0. Intraband p-p coupling is shown to dominate the changes in Δ_0.

22640 **Application of reflection mass spectrometry to molecular-beam epitaxial growth of InAlAs and InGaAs.** Brennan, T.M.; Tsao, J.Y.; Hammons, B.E.; Klem, J.F.; Jones, E.D. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* **7**: No. 2, 277-282(Mar 1989).

Reflection mass spectrometry (REMS) has been used to monitor In fluxes leaving the surface, and to optimize growth conditions during molecular-beam epitaxial (MBE) growth of InAlAs and InGaAs on InP. The optical, electrical, and structural properties of the films are shown to be a function of the measured indium signal. This optimization technique is independent of thermocouple or pyrometer readings to set the growth temperature, and has led to significant improvements in the optical and electrical properties of lattice matched InAlAs on InP. REMS-optimized unintentionally doped InAlAs has been grown with electron concentrations as low as 3 x $10^{15}/cm^3$, electron mobilities as high as 4 000 cm^2/V s at 77 K, and photoluminescence linewidths as narrow as 10 meV. The high quality of these layers is attributed to reduced alloy clustering and reduced ionized impurity scattering.

22641 **Dynamics of growth roughening and smoothening on Ge (001).** Chason, E.; Tsao, J.Y.; Horn, K.M.; Picraux, S.T. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* **7**: No. 2, 332-336(Mar 1989).

We present reflection high-energy electron diffraction measurements of the evolution of surface morphology during molecular-beam epitaxy of Ge on Ge(001) and subsequent annealing. We find that there is a critical "kinetic roughening" temperature (375 °C) above which a smooth surface remains smooth during growth, but below which it roughens during growth. Surprisingly, smooth starting surfaces never appear to roughen without bound, but reach steady-state roughnesses which depend on temperature and deposition rate. The results can be fit empirically with simple phenomenological equations based on a competition between growth roughening and growth smoothening of a "pseudo-statistical" surface. Furthermore, growth-roughened surfaces tend to smoothen, after

growth, at a rate consistent with a third-order power-law ripening mechanism.

22642 **Influence of the Si evaporation source on the incorporation of In during Si molecular-beam epitaxy growth: A comparative study of magnetically and electrostatically-focused electron-gun evaporators.** Knall, J.; Sundgren, J.; Markert, L.C.; Rockett, A.; Greene, J.E. (Department of Materials Science, Coordinated Science Laboratory, and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* 7: No. 2, 204-209(Mar 1989).

The incorporation behavior of thermally evaporated In during the growth of Si(100) by molecular-beam epitaxy has been observed to depend critically on whether a magnetically focused electron gun (MFG) or electrostatically focused electron gun (EFG) evaporation source was used for Si evaporation. When a MFG source was used, the incorporation probability σ was found to be very low during growth on grounded substrates, but could be increased considerably by the application of a negative substrate bias between 100 and 2000 V. This increase was due to Si^+ ion bombardment of the In surface overlayer resulting in secondary implantation during growth. For deposition on electrically grounded substrates, σ was found to be much higher during growth with the EFG source than with the MFG source. This was primarily due to bombardment of the In overlayer by energetic neutral Si atoms emitted from the EFG source.

22643 **Compositional modulations in Ge/sub x/Si/sub 1-//sub x/ heteroepitaxial layers.** Fraser, H.L.; Maher, D.M.; Knoell, R.V.; Eaglesham, D.J.; Humphreys, C.J.; Bean, J.C. (University of Illinois, Urbana-Champaign, Illinois 61801). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* 7: No. 2, 210-213(Mar 1989).

A study is presented of compositional modulations (i.e., so-called banding) in heteroepitaxial strained layers of nominally uniform Ge/sub 0.1/Si/sub 0.9/ grown by molecular-beam epitaxy (MBE). The oscillatory nature of the modulations is studied by transmission electron microscopy (TEM) techniques and the results show that the contrast modulations have a periodicity of {similar←to}23 nm when 1-μm-thick epilayers are grown on a rotated substrate. For growth on an unrotated substrate, contrast modulations are still observed but they are less regular. It is further shown that the electron microscope image features are dominated by strain contrast and not structure factor contrast. The presence of strain is consistent with there being a small change in lattice parameter between adjacent bands of material, together with elastic relaxations afforded by the proximity of the thin-film surfaces. It is concluded that these variations in the lattice parameter are due to the compositional modulations. Limits on the magnitude (Δx) of the compositional modulations are assessed from considerations of diffraction contrast theory (giving an upper limit) and elasticity theory (giving a lower limit). The upper and lower limits for the compositional modulations, assuming an average 9 at. % Ge--Si epilayer, are +- 1 at. % and +- 0.25 at. % Ge, respectively. The origin of these compositional modulations is thought to be associated with equipment instabilities or a metastable miscibility gap.

22644 **Optical and structural properties of molecular-beam epitaxial GaAs on sapphire.** Chin, A.; Bhattacharya, P.; Chang, K.H.; Biswas, D. (Solid State Electronics Laboratory, Department of Electrical Engineering and Computer Science, University of Michigan, Ann Arbor, Michigan 48109-2122). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* 7: No. 2, 283-288(Mar 1989).

We have evaluated the structural and optical properties of GaAs grown by molecular-beam epitaxy on (0001) and (011-bar2)-oriented sapphire substrates for possible direct deposition on sapphire optical fibers and optoelectronic device applications. X-ray diffraction studies and cross-sectional transmission electron microscopy measurements show that the GaAs films are single-crystal and have a (111) orientation for both substrate orientations. Both x-ray and temperature-dependent photoluminescence measurements indicate that the quality of the GaAs films is better for the (011-bar2) sapphire orientation. The best results are produced when growth is initiated at a very slow rate ({similar←to}0.1 μm/h) and low temperature ({similar←to}400 °C) followed by growth parameters for normal homoepitaxial GaAs (1 μm/h, 560--600 °C). The incorporation of a graded band gap strained layer in InGaAs/GaAs superlattice near the sapphire--GaAs interface also improves the optical quality of the GaAs films. Low-temperature photoluminescence spectra is dominated by a peak at 1.49--1.495 eV, with a best linewidth of 26.9 meV, which we believe is due to an integration of several impurity and defect related bound exciton transitions. A peak to lower energies by {similar←to}60 meV is thought to be due to acceptorlike impurity defect complexes. Post growth short term halogen lamp annealing marginally improves the overall luminescence intensity of the samples. A linewidth of 20 meV is measured for a (80 A) GaAs/(120 A) Al/sub 0.3/ Ga/sub 0.7/ As multiquantum grown on sapphire.

22645 **Use of Raman spectroscopy to characterize strain in III--V epilayers: Application to InAs on GaAs(001) grown by molecular-beam epitaxy.** Diebold, A.C.; Steinhauser, S.W.; Mariella R.P. Jr. (Allied-Signal, Inc., Electronic Materials and Devices Laboratory, Morristown, 07960 New Jersey). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* 7: No. 2, 365-370(Mar 1989).

Strain in thin layers of molecular-beam epitaxy (MBE) grown InAs on GaAs(001) was characterized by both Raman spectroscopy and double crystal x-ray diffraction (DCD). The goal of this study was to evaluate the use of Raman spectroscopy as a method of strain determination and compare it to DCD. Recent results of Burns et al., for In/sub x/Ga/sub 1-//sub x/As proved that Raman spectroscopy could be an important in situ analysis method for MBE [G. Burns, C. R. Wie, F. H. Dacol, G. D. Pettit, Appl. Phys. Lett. 51, 1919 (1987)]. We find that Raman spectroscopy has several advantages over DCD. Raman data samples the stress in a much thinner volume than DCD, allowing one to determine when a surface layer of the thin film is no longer under stress. Films that are highly lattice mismatched with the substrate have a large number of defects at the substrate/epilayer interface. Raman analysis determines straain in a more defect free layer of these films when the layer thickness is greater than t/sub c/, the critical thickness. DCD samples an average strain over the entire thickness of most semiconductor films. There are several disadvantages in the use of Raman spectroscopy as a strain analysis method. We found that the materials parameters of InAs required to calculate the strain from the shift in the optical phonon energy of the epilayer were not accurately known. Quantitative strain determination by Raman spectroscopy depends on accurate values of the phonon deformation potentials of InAs and other III--V compounds of interest. Also, DCD is capable of determining much smaller strains than Raman spectroscopy.

22646 **Carbonaceous film coating.** Maya, L. (to US Dept. of Energy). US Patent Application 7-186,427. 27 Apr 1988. 14p. Contract AC05-84OR21400. DE89009592 NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009592/JAW.

A method of making a carbonaceous film comprising heating tris(1,3,2-benzodiazaborolo)borazine or dodecahydro tris[1,3,2]diazaborine[1,2-a:1′2′-c:1″2″-e]borazine in an inert atmosphere in the presence of a substrate to a temperature at which the borazine compound decomposes, and the decomposition products deposit onto the substrate to form a thin, tenacious, highly reflective conductive coating having a narrow band gap which is susceptible of modification and a relatively low coefficient of friction.

22647 **Nonlinear optics at interfaces.** Shen, Y.R. (Materials and Chemical Sciences Div., Lawrence Berkeley Lab., Berkeley, CA (US)). pp v of Proceedings of the Electrochemical Society fall meeting. Volume 88-2 (extended abstracts). Pennington, NJ; The Electrochemical Society (1988). (CONF-881061—).

From Electrochemical Society fall meeting; Chicago, IL, USA (9 Oct 1988).

Nonlinear optical effects at interfaces are weak but are easily detectable. Second-order nonlinear optical processes, in particular, can be highly sensitive and surface-specific. They can be exploited to study surfaces and interfaces. That the techniques are extremely versatile and possess many advantages over conventional surfaces probes is now well established. Possible applications of the techniques to various disciplines can lead to many interesting new research to opportunities. The recent status and progress in the field will be reviewed and future prospects are discussed.

22648 **Electrical resistivity response due to elastic-plastic deformations.** Stout, R.B. (Lawrence Livermore National Lab., Livermore, CA (US)). pp v of Techniques and theory of stress measurements for shock wave applications. Stout, R.B.; Norwood, F.R.; Fourney, M.E. Houston, TX; Industrial Presentations Inc. (1987). (CONF-8706186—).

From ASME applied mechanics, bioengineering and fluid engineering conference; Cincinnati, OH, USA (14 Jun 1987).

The electrical resistivity of many materials is sensitive to changes in the electronic band configurations surrounding the atoms, changes in the electron-phonon interaction cross-sections, and changes in the density of intrinsic defect structures. Changes in the electronic band configurations, electron-phonon cross-sections, and defect structures are most directly dependent on interatomic measures of relative deformation. For this reason, a model for resistivity response is developed in terms of interatomic measures of relative deformation. The relative deformation consists of two terms, a continuous function to describe the recoverable displacement between two atoms in the atomic lattice structure and a functional to describe the nonrecoverable displacement between two atoms as a result of interatomic discontinuties from dislocation kinetics. This model for resistivity extends the classical piezoresistance representation and relates electric resistance change directly to physical mechanisms. An analysis for the resistivity change of a thin foil ideally embedded in a material that undergoes elastic-plastic deformation is presented. For the case of elastic deformations, stress information in the material surrounding the thin foil is inferred for the cases of pure strain coupling boundary conditions, pure stress coupling boundary conditions, and a combination of stress-strain coupling boundary conditions.

22649 **Pinhole camera for hot environment viewing of electron beam materials processing.** Rushford, M.C.; Kuzmenko, P.J. (Lawrence Livermore National Lab., P.O. Box 808, L-470, Livermore, CA (US)). pp v of Optical techniques for sensing and measurement in hostile environments. Gillespie, C.H.; Greenwell, R.A. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8705231—).

From Optical techniques for sensing and measurement in hostile environments; Orlando, FL, USA (21 May 1987).

A very rugged, compact (3x3x10 inches), gas purged pinhole camera has been developed for viewing electron beam materials processing (e.g. melting or vaporizing metal). The video image is computer processed, providing dimensional and temperature measurements of objects within the field of view, using an IBM PC. The "pinhole camera" concept is similar to a TRW optics system for viewing into a coal combustor through a 2 mm hole. Gas is purged through the hole to repel particulates from optical surfaces. In the authors' system light from the molten metal passes through the 2 mm hole pinhole, reflects off an aluminum coated glass substrate and passes through a window into a vacuum tight container holding the camera and optics at atmospheric pressure. The mirror filters out X-rays which pass through the AL layer and are absorbed in the glass mirror substrate. Since metallic coatings are usually reflective, the image quality is not severly degraded by small amounts of vapor that overcome the gas purge to reach the mirror. Coating thicknesses of up to 2 microns can be tolerated. the mirror is the only element needing occasional servicing. Single frames of video output are acquired for feature enhancement and location by a Data Translation DT2803 image processing board housed in an IBM PC.

22650 **Dynamic emission of dislocations from a crack tip - A computer simulation.** Zhao, R.H.; Dai, S.H.; Li, J.C.M. (Univ. of Rochester, Rochester, NY (US)). pp v of Proceedings of ICF international symposium on fracture mechanics. Utrecht, Netherlands; VNU Science Press (1984). (CONF-831101—).

From International symposium on fracture mechanics; Beijing, China (22 Nov 1983).

A computer simulation of dislocation emission from a crack tip in the Mode II or III situation is presented. It is found that the rate of dislocation emission always decreases with time for a given σ, K/sub D/ and tau/sub F/. When the crack is allowed to propagate with a velocity proportional to a power function of the effective stress intensity factor, a steady state number of dislocations can be maintained in front of the crack.

40 CHEMISTRY

22651 **(GSF-PC—33/88) Information system environmental chemicals. A pilot study.** Voigt, K.; Benz, J. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Umweltgefaehrdungspotentiale von Chemikalien; Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany, F.R.)). Apr 1988. 82p. (In German). Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Umweltgefaehrdungspotentiale von Chemikalien.

In the pilot study "information system environmental chemicals", an electronic data processing system was created to gain and to optimize access to information on chemicals. For this purpose, three data bases were set up to record the contents of data sources (data bases of data sources): PUCLIT to record printed documents, PUCDB to record on-line data bases, PUCSO to record special prints. To verify the capability of performance of the information system created, a thesaurus was developed having a hierarchical structure. The number of items of information found (hits) per compound ranged from zero to several hundred. Results were recorded in the PUC68 facts data-base. For access to on-line data bases, a special communication software NPF-PC (Network Pass Through Facility) was developed, tested and applied. This software is adapted to the problem formulation to an optimum extent. To assist the acquisition of chemicals data, a concept was developed allowing to point out to the user for a given question (information sought, information already at hand) possible search paths and respective procedure.

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REFER ALSO TO CITATION(S) 21719, 21738, 21743, 21884, 22132, 22136, 22270, 22676, 22686, 22700, 23069, 23088, 23199

22652 **(BARC—1426) Optical emission spectrographic analysis of thulium oxide for rare earth impurities.** Chandola, L.C.; Khanna, P.P.; Dixit, V.C. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1988. 19p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706140/JAW.

An optical emission spectrographic method has been developed for the analysis of high purity thulium oxide to determine rare earth elements Er, Yb, Lu and Y. A 1200 groove/mm grating blazed at 3300 A is used to record the spectrum on Kodak SA-1 photographic plates after the excitation of the graphite-sample (1:1) mixture in DC arc. The determination range is 0.008 per cent to 0.1 per cent and the relative standard deviation is 17.6 per cent. (author). 15 refs., 5 tables, 5 figs.

22653 **(DOE/ER/13218—23) Theta pinch discharges for solids vaporization and elemental chemical analysis: Progress report, December 1, 1987--February 2, 1989.** (Illinois Univ., Urbana (USA)). 1989. Contract FG02-84ER13218. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008888/JAW.

This period covered is from month 9 to month 22 of the 3 year renewal of the above named project. The goal of the project is to develop the theta pinch discharge as a source for elemental analysis of non-volatile solid materials. The first three years of research resulted in knowledge of how to design a functioning discharge system, and of how to resolve the emission in time to optimize signal-to-background ratio. Sampling was possible on a variety of materials, but was still not sufficient for purposes of universal solids analysis. The first 8 months of current grant saw the beginnings of operation of a discharge system using a 6 μF capacitor; this system has operated reliably for the entire year. Total firings of the pinch this year have approached 1000. We have pursued hardware development, studies of sampling, excitation, and vapor propagation, and made our first attempts at doing quantitative analyses. 1 ref.

22654 **(DOE/ER/13678—11) The use of micellar-enhanced ultrafiltration to remove dissolved organics and multivalent transition metal cations from aqueous streams.** Dunn, R.O. Jr. (Oklahoma Univ., Norman (USA)). 1987. Contract FG05-87ER13678. 281p. NTIS, PC A13/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005144/JAW.

Micellar-enhanced ultrafiltration (MEUF{trademark}) is a recently developed surfactant based separation technique. Advantages of the process are low energy consumption and potential to produce high rejection ratios with reasonably high fluxrates. Surfactant is introduced into a given waste stream at a concentration higher than its critical micelle concentration. The studies herein investigate the application of MEUF{trademark} for the removal of an organic alone, a heavy metal cation alone, and both species simultaneously. 73 refs., 47 figs., 17 tabs.

22655 **(DOE/ER/40079—T1) Development of immobilized ligands for actinide separations: Final report, June 1985--May 1988.** Paine, R.T. (New Mexico Univ., Albuquerque (USA). Dept. of Chemistry). 1988. Contract AS04-82ER40079. 30p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009043/JAW.

A discussion on the separation of actinides in presented. Preparation of CMP-like ligands with phosphonic acid attachments was discussed and zirconium phosphonate support preparation and characterization studies will be studied in the next quarter. 68 refs. (CBS)

22656 **(IYaF—88-82) Application of the method of X-ray fluorescence analysis with synchrotron radiation to study lunar matter.** Tarasov, L.S.; Kudryashova, A.F.; Baryshev, V.B.; Kulipanov, G.N.; Skrinskij, A.N. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1988. 30p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705782/JAW.

Possibilties of X-ray fluorescence analysis using synchrotron radiation are considered, microamounts of lunar samples being studied as examples. It is shown that the method permits to determine the composition of particles with the mass from 2 to 0.05 μg when the content of elements is at the level of 1 x 10/sup -4/% and higher. Systematic geochemical data on the distribution of Sr, Y, Ce, La and other elements in lunar minerals and rocks are obtained. A great geochemical value of data on strontium distribution in the rocks is pointed out. 7 refs.; 6 figs.; 6 tabs.

22657 **(JINR—18-88-204) Use of resonance neutrons for analyzing superclean aluminium.** Belyakov, Yu.I.; Men'shikov, V.I.; Serdyuk, V.V.; Tomilov, S.B.; Nazarov, V.M.; Strelkova, L.P.; Chinaeva, V.P.; Erdelyvary, I. (Vsesoyuznyj Nauchno-Issledovatel'skij i proektnyj Institut Alyuminievoj, Magnievoj i Ehlektrodnoj Promyshlennosti, Leningrad (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1988. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706221/JAW.

Submitted to the journal Zh. Anal. Khim. .

The content of microimpurities of different elements in samples of superclean aluminium obtained by the zone melting method was determined by the neutron activation analysis on the IBR-2 reactor of Laboratory of neutron Physics, JINR. 28 elements have been discovered in the samples investigated, among them for 22 elements the concentrations have been determined as lying within the range of (10/sup -4/-10/sup -9/) weight %. Values of purification degree for various impurity elements have been determined for different impurity elements within the 10/sup -3/ upto 0.8 range. 8 refs.; 3 figs.; 6 tabs.

22658 **(JINR—R-14-88-198) Neutron activation analysis for long-lived induced radioactivity investigations of concretes used in nuclear reactor shielding constructions.** Lavdanskij, P.A.; Stefanov, N.I.; Nazarov, V.M.; Frontas'eva, M.V. (Moskovskij Inzhenerno-Stroitel'nyj Inst. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1988. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706262/JAW.

Submitted to the journal J. Radioanal. Nucl. Chem., Articles.

Elementary content in aggregates of shielding concretes (portlandcement, gabbro, sand, granite, hematite, limestone) was investigated to reveal nuclides mainly contributing into long-lived radioactivity of concretes used in nuclear reactors by neutron activation analysis at the IBR-2 reator of the LNP of JINR. It is shown that the nuclides mainly responsible for the long-lived radioactivity are /sup 152/Eu, /sup 154/Eu, /sup 60/Co and /sup 134/Cs. Calculations of the specific radioactivity of aggregates after irradiation fo 30 years by the neutron flux of unit density have been done on the basis of the experimental data. The dependences of the specific radioactivity versus time are presented graphically. Restructions on the use of such aggregates as magnetite, chromite, serpentinite in shielding constructions are recommended. The estimations of the dose rate from the concrete construction containing different aggregates in the approximation of semifinite space are given. The obtained results can serve as basis for the optimal choose of aggregates in concretes for nuclear set-up shielding constructions. 11 refs.; 2 figs.; 3 tabs.

22659 **(LBL—25571) Extraction of carboxylic acids by amine extractants.** Tamada, Janet Ayako; King, C.J. (Lawrence Berkeley Lab., CA (USA)). Jan 1989. Contract AC03-76SF00098. 397p. NTIS, PC A17/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008486/JAW.

This work examines the chemistry of solvent extraction by long-chain amines for recovery of carboxylic acids from dilute aqueous solution. Long-chain amines act as complexing agents with the acid, which facilitates distribution of the acid into the organic phase. The complexation is reversible, allowing for recovery of the acid from the organic phase and regeneration of the extractant. Batch extraction experiments were performed to study the complexation of acetic, lactic, succinic, malonic, fumaric, and maleic acids with Alamine 336, an aliphatic, tertiary amine extractant, dissolved in various diluents. Results were interpreted by a "chemical" model, in which stoichiometric ratios of acid and amine molecules are assumed to form complexes in the solvent phase. From fitting of the extraction data, the stoichiometry of complexes formed and the corresponding equilibrium constants were obtained. The results of the model were combined with infrared spectroscopic experiments and results of past studies to analyze the chemical interactions that are responsible for extraction behavior. The information from the equilibrium studies was used to develop guidelines for large-scale staged extraction and regeneration schemes. A novel scheme, in which the diluent composition is shifted between extraction and regeneration, was developed which could achieve both high solute recovery and high product concentration. 169 refs., 57 figs., 15 tabs.

22660 **(NSS/R—112) Review of the potential of photoacoustic and photothermal spectroscopy for the characterisation of actinide solid phases.** Liezers, M.; McMillan, J.W.; Pollard, P.M. (Manchester Univ. (UK). Inst. of Science and Technology; UKAEA Harwell Lab. Chemistry Div.). (UKAEA Harwell Lab. Chemistry Div.; Department of the Environment, London (UK)). Sep 1988. 24p. (AERE-R—12994; DOE-RW—88.091). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706116/JAW.

As the solid actinide compounds encountered in radioactive wastes have widely differing aqueous solubilities, methods are required to determine their composition. Analytical methods with the potential to characterise solid actinide compounds in equilibrium with an aqueous phase are reviewed. 'Direct', essentially non-invasive methods were sought. The most promising were identified as photoacoustic and photothermal spectroscopies. A programme is suggested for their study and exploitation.

22661 **Time-resolved laser optogalvanic spectroscopy of iodine in a radio frequency discharge.** Kumar, D.; Clancy, P.L.; McGlynn, S.P. (Department of Chemistry, Louisiana State University, Baton Rouge, Louisiana 70803). *Journal of Chemical Physics;* **90**: No. 8, 4008-4014(15 Apr 1989).

Pulsed laser optogalvanic (LOG) spectra of iodine vapor in a {similar←to}32 MHz rf discharge were excited at 14 900--17 100 cm^{-1}. Two distinct, time-resolved components were observed: a fast component, synchronous with the laser pulse, width {similar←to}1 μs, followed by a slow component, width {similar←to}100 μs, delayed relative to the laser pulse. The fast component exhibits atomic transitions of I(I) and I(II). The slow component reproduces the B-italic-tildeleft-arrowX photoacoustic (PA) spectrum of molecular I_2. The signal delay of the slow component accords with the velocity of acoustic waves in iodine vapor. The rf electrode region is the "sensitive" region where the acoustic wave generates the slow LOG signal. Two mechanisms of signal generation and propagation are involved. The fast signal originates in a two-step laser photoionization of plasma-excited atoms, the first-step being resonant, and/or in changes of the atomic collisional ionization rates. These processes occur on time scales shorter than the laser pulse and generate an "instantaneous" LOG signal by creating additional electron--ion pairs. The delay of the molecular LOG signal, which is mediated by the PA effect, indicates that local heating produces a negligible perturbation of the discharge impedance. This is contrary to common belief. The polarity of the slow LOG signal depends on the direction of the PA wave, suggesting that the signal is generated by an actual physical movement of charged species by the pressure wave. Thermal effects are involved, but only as precursors to the PA wave.

22662 **Two-photon-excited stimulated emission from atomic oxygen in flames and cold gases.** Alden, M.; Westblom, U.; Goldsmith, J.E.M. (The Combustion Center, Lund Institute of Technology, P.O. Box 118, S-221 00 Lund, Sweden). *Optics Letters;* **14**: No. 6, 305-307(15 Mar 1989).

We report detection of stimulated emission from the atomic-oxygen 3 ^3P--3 ^3S transition at 845 nm after two-photon excitation of the 2 ^3P--3 ^3P transition using 226-nm laser radiation. We study this stimulated emission process in flames and in room-temperature flows of O_2 and N_2O and compare its behavior with that of fluorescence signals acquired simultaneously. Rapid depletion of the laser-excited state by the stimulated emission process may have an impact on the use of diagnostic techniques based on multiphoton excitation in oxygen and in other species. The strength of the stimulated emission signal suggests that it may have applications as a diagnostic technique.

22663 **Experimental observation of steric transition phenomena in sedimentation field-flow fractionation.** Lee, S.; Giddings, J.C. (Univ. of Utah, Salt Lake City (USA)). *Analytical Chemistry;* **60**: No. 21, 2328-2333(1 Nov 1988). Contract FG02-86ER60431.

The steric transition region of field-flow (FFF) is described as that part of a fractogram, found at very high retention volumes, in which normal FFF undergoes a transition to steric FFF by virtue of increasing particle diameter. The steric transition region is treated theoretically by assuming first that the steric factor γ is constant and second that it is related by a simple power law to particle diameter. The authors then report the first experiments in which fractograms display the characteristic signature predicted by theory for the steric transition: a narrow terminal peak followed by a rapid dropoff to base line. It is shown that the steric transition point, which coincides with the dropoff, is displaced to higher retention volumes with increasing field strength, approximately as expected. The expected steric transition phenomena are further confirmed by collecting narrow fractions of a polydisperse poly(vinyl chloride) sample near the steric transition point and subjecting them to electron microscopy. The particle size distribution of the fractions is found to be sharply bimodal, in accordance with steric transition theory. However, satisfactory agreement between the measured particle diameters and the theoretical expressions is found only by application of the more complicated equations in which γ is assumed to be size dependent.

22664 **Analytical solution for the ideal model of chromatography in the case of Langmuir isotherm.** Golshan-Shirazi, S.; Guiochon, G. (Univ. of Tennessee, Knoxville (USA)). *Analytical Chemistry;* **60**: No. 21, 2364-2374(1 Nov 1988).

An exact solution of the ideal model of chromatography for one compound is derived in the case of Langmuir isotherm (C/sub s/ = aC/sub m//(1 + bC/sub m/), where C/sub s/ is the amount of solute sorbed per unit mass of packing material, in equilibrium with a concentration C/sub m/ in the mobile phase). A set of reduced coordinates can be chosen that permits the representation of the elution profiles as a set of curves that are a function of only the reduced sample size. The reduced time is (t - t/sub O/)/(t/sub R,O/ - t/sub O/), which provides a time scale independent of the first isotherm parameter, a. The reduced ordinate is bC/sub m/. The reduced sample size is the loading factor, i.e., the ratio of the sample size to the amount of sample that would completely saturate the column. With the parameters of the isotherm known, it is easy to predict the elution band profile for any sample size. With the sample size known, it is easy to calculate the parameters of the best Langmuir isotherm. From these the profile of the elution band of any sample size can be predicted. The bands eluted from real columns having several thousands of theoretical plates are so sharp that the effects of axial diffusion and of the radial resistance to mass transfer introduce only very small deviations that can be corrected easily by using a dimensionless plot. This method is rigorous. It is more general than the empirical approaches recently suggested. It is easier to use and provides more accurate predictions.

22665 **Real-time, on-line determination of carbon monoxide using charge exchange with krypton in a triple quadrupole mass spectrometer.** Crawford, R.W.; Alcaraz, A.; Reynolds, J.G. (Lawrence Livermore National Lab., CA (USA)). *Analytical Chemistry;* **60**: No. 21, 2439-2441(1 Nov 1988). Contract W-7405-ENG-48.

A triple quadrupole mass spectrometer (TQMS) is used as an on-line analyzer for pyrolysis products from oil shale, tar sands, and coal. Besides determining many hydrocarbon as well as 10 sulfur-containing species, it is important to determine the major oxygen-containing products: H_2O, CO_2, CO, and COS. CO is a particular challenge. It is impractical to remove the ubiquitous contribution of hydrocarbons to the ion at m/z 28 when using the normal MS mode and the product fragment at m/z in 16 MS/MS mode is unsatisfactory. With the replacement of Ar with Kr as the collision gas in the TQMS, a charge transfer reaction takes place with the CO^+ ion but not hydrocarbon fragment ions of mass 28. By use of MS/MS mode with m/z 28 precursors, the major isotope of Kr at m/z 84 was monitored; this charge exchange product was linearly proportional to CO^+.

22666 **IR external reflection spectroscopy: a probe for chemically modified surfaces.** Porter, M.D. (Iowa State Univ., Ames (USA)). *Analytical Chemistry;* **60**: No. 20, 1143A-1155A(15 Oct 1988). Contract W-7405-ENG-82.

During the past decade, infrared spectroscopy (IR-ERS) has emerged as an important tool for probing molecular structures and modes of bonding at chemically modified surfaces. In this report, a few recent developments in the application of IR-ERS to the qualitative and quantitative characterization of chemically modified surfaces are discussed. Emphasis is placed on examples that illustrate the utility of this technique for probing the composition and spatial arrangement of organic polymer films and monomolecular assemblies at surfaces with both high and low IR reflectivities. In addition, the importance of examining the underlying optical phenomena that govern the passage of electromagnetic radiation from one medium to another are discussed. Such considerations provide a means to select conditions for high detectability (primarily a function of substrate reflectivity) and to separate shifts and distortions

of spectral band shapes caused by optical effects from those caused by surface-induced changes in structure or chemical bonding.

22667 **Statistical evaluation of dead time effects and pulse pileup in past photon counting. Introduction of the sequential model.** Williamson, J.A.; Kendall-Tobias, M.W.; Buhl, M.; Seibert, M. (Univ. of Colorado, Boulder (USA)). *Analytical Chemistry;* **60**: No. 20, 2198-2203(15 Oct 1988). Contract AC02-83CH10093.

Corrections to photocount distributions due to dead-time effects are evaluated by the use of a new pulse-pileup model incorporating a paralyzable portion and nonparalyzable component in sequence. In the simple model, the two dead times are regarded as nonvarying. A more complete mode is presented in the Appendix, which incorporates dead times that are themselves random variables.

22668 **Atmospheric sampling glow discharge ionization source for the determination of trace organic compounds in ambient air.** McLuckey, S.A.; Glish, G.L.; Asano, K.G.; Grant, B.C. (Oak Ridge National Lab., TN (USA)). *Analytical Chemistry;* **60**: No. 20, 2220-2227(15 Oct 1988). Contract AC05-84OR21400.

A new atmospheric sampling ion source, based on the establishment of a glow discharge in ambient air drawn into a region of reduced pressure, is described. The source is simple, rugged, and relatively maintenance-free, exhibits a very short memory, and is extremely sensitive for compounds with high proton affinities, high electron affinities, high gas-phase acidities, and/or low ionization potentials. The effects of discharge voltage and ion source pressure on the nature of the mass spectra observed are described. These operating parameters affect the absolute number of ions observed and, particularly for positive ions, affect the distribution of the reagent ions and the degree of fragmentation. For illustrative purposes, the limit of detection of dynamic range of the ion source coupled with a mass spectrometer are discussed for 2,4,6-trinitrotoluene. For the present system, a detection limit of 1-2 parts per trillion and a linear dynamic range of at least 6 orders of magnitude are observed.

22669 **Detection of metal ions by liquid chromatographic separation of their 1,3-dimethyl-4-acetyl-2-pyrazolin-5-one chelates.** Palmieri, M.D.; Fritz, J.S. (Iowa State Univ., Ames (USA)). *Analytical Chemistry;* **60**: No. 20, 2244-2248(15 Oct 1988). Contract W-7405-ENG-82.

Metal ions are determined by adding 1,3-dimethyl-4-acetyl-2-pyrazolin-5-one (DMAP) to an aqueous sample and then separating the metal chelates by direct injection onto a liquid chromatographic column. Separations on a C-18 silica column and a polystyrene-divinylbenzene column are compared, with a better separation seen on the polymeric column. It is found that the most efficient separations are seen at pH 5 with an acetic acid buffer. Separations of metal-DMAP complexes using different organic modifiers are compared. Good separations using acetonitrile and tetrahydrofuran are seen, and an inversion of retention is seen in tetrahydrofuran. Several metal ions can be separated and quantified; separation conditions, linear calibration curve ranges, and detection limits are presented for Fe(III), U(VI), Ga(III), and Cu(II). Interferences due to the presence of other ions in solution are investigated. Finally a method for selectively determining uranium with postcolumn reactor detection using Arsenazo I is presented.

22670 **Acoustic signal as an internal standard for quantitation in laser-generated plumes.** Chen, G.; Yeung, E.S. (Iowa State Univ., Ames (USA)). *Analytical Chemistry;* **60**: No. 20, 2258-2263(15 Oct 1988). Contract W-7405-ENG-82.

To correct for pulse-to-pulse variations in laser-generated plumes, one needs to monitor the total amount of material vaporized during each pulse. The authors found that the magnitude of the acoustic wave associated with plume generation is linearly related to the emission intensities of both major and minor elements in the sample. Over a wide range of vaporization conditions, including laser power, focusing, and surface pretreatment, and over a limited range of composition, the two signals are well correlated with each other. This implies that the acoustic signal can be used as an internal standard for normalizing analytical signals derived from laser-generated plumes.

22671 **Self chemical ionization in an ion trap mass spectrometer.** McLuckey, S.A.; Glish, G.L.; Asano, K.G.; Van Berkel, G.J. (Oak Ridge National Lab., TN (USA)). *Analytical Chemistry;* **60**: No. 20, 2312-2314(15 Oct 1988). Contract AC05-84OR21400.

The conditions under which ion/molecule reactions, and self-CI reactions in particular, are likely to occur in the ion trap detector (ITD) and the closely related ion trap mass spectrometer (ITMS) are elucidated.

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REFER ALSO TO CITATION(S) 21632, 21635, 21708, 21742, 21895, 21899, 21978, 22396, 22529, 22591, 22593, 22659, 22735, 23070, 23199, 23345, 23346, 23347, 23350, 23352, 23372, 23864

22672 **(BARC—1419) Boron sorption characteristics in resins.** Nathan, U.; Chhokera, A.R.; Rao, D.P.; Iyer, C.S.P. (Bhabha Atomic Research Centre, Bombay (India). Reactor Engineering Div.; Bhabha Atomic Research Centre, Bombay (India). Reactor Projects Div.; Bhabha Atomic Research Centre, Bombay (India). Analytical Chemistry Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1988. 42p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706137/JAW.

The purpose of boron addition in a nuclear power plant is to control the reactivity. In PHWRs, it is injected into the moderator system in the form of boric anhydride solution, while in PHWRs, it is added to the primary heat transport system in the form of boric acid solution. The required boron levels in PHWRs are controlled by valving in strong base anion exchangers having exchangeable species in OD/sup -/ form while in PHWRs, the same can be achieved by restoring to the use of Boron Thermal Regeneration System (BTRS). This system operates on the principle of existence of different amounts of various polyborate ions at different temperatures, solution pH's and the boric acid concentrations and on the reversible sorption of these polyions on strong base anion exchange resins. This report describes the salient features of boron sorption characteristics on four types of anion exchange resins, based on experimental data generated in the chemical laboratories of Reactor Engineering Division of the Bhabha Atomic Research Centre, Bombay. The report further makes an attempt to calculate the pH of the resin and solution phases and the percentages of different polyborates and undissociated boric acid, under the experimental conditions investigated. (author). 30 refs., 4 figs., 20 tables.

22673 **(CEA-tr—2319) Gas isotope separation method using plasma sheet.** Takayama, K.; Takagi, K.; Fukvi, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Mar 1988. 8p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757192/JAW.

A high frequency electric field is applied to a plasma sheet with a frequency equal to the cyclotronic frequency of the ions to be separated. Because of resonance the cyclotronic radius of the isotope has increased and the electric charge is eliminated by collision with a separator and the isotope is separated in neutral particles.

22674 **(CONF-890437—4) Transport kinetics in thermally oxidized alloys exposed to oxygen-sulfur bioxidant environments.** Park, J.H.; Natesan, K. (Argonne National Lab., IL (USA)). Oct 1988. Contract W-31109-ENG-38. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004266/JAW.

From Corrosion '89; New Orleans, LA, USA (17 Apr 1989).

The diffusivity of oxygen and sulfur in a thermally grown Cr_2O_3 have been determined by means of electrical conductivity measurements. Electrical conductivity of the oxide at temperatures between 700{degree}C and 950{degree}C and pO_2 = 10/sup {minus}4/ atm decreased due to doping of a trace amount of sulfur. The measured diffusivity of sulfur in Cr_2O/sub sub 3/ is at least one to two orders of magnitude higher than that of oxygen. The activation energy for oxygen diffusion is 3.53 eV, whereas the value for sulfur diffusion, (0.8 eV) is much lower. In order to

define the carrier concentration from electrical conductivity data, the hole mobility was measured by applying a constant composition technique. The solubility of sulfur decreased with an increase in temperature, but was almost constant below 800{degree}C. 22 refs. 12 figs.

22675 **(DOE/ER/13350—5) Support effects studied on model supported catalysts: [Progress report].** Gorte, R.J. (Pennsylvania Univ., Philadelphia (USA). Dept. of Chemical Engineering). 1989. Contract FG02-85ER13350. 8p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009298/JAW.

Research on the sorptive properties of platinum and rhodium is presented. Growth modes of the metals, interactions with the catalyst supports aluminum oxide, sapphire, zinc oxide, titania, and desorption of carbon monoxide and nitrogen oxides are discussed. (CBS)

22676 **(DOE/ER/13619—3) Resonance Raman and photophysical studies of polypyridine complexes of ruthenium: Progress report, March 1, 1988--February 28, 1989.** Kincaid, J.R. (Marquette Univ., Milwaukee, WI (USA). Dept. of Chemistry). 25 Oct 1988. Contract FG02-86ER13619. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008746/JAW.

During this budget period progress was made on the objectives described in the initial application. In addition, we recognized an opportunity to effectively investigate an issue of potentially great interest; namely, the behavior of polypyridine complexes in restricted environments. This report is divided into two major sections. The first part deals with those issues initially addressed in the original application. Several new isotopically labeled complexes have been prepared and the normal coordinate calculation of the ^{3}MLCT excited state is now essentially completed. The study of several mixed-ligand complexes is also nearing completion. Part II describes the results of our initial studies of Zeolite-entrapped complexes. In addition to acquiring the ground and excited state resonance Raman spectra of the zeolite-entrapped parent compound, we have devised a general synthetic route for zeolite-entrapped mixed ligand complexes which should facilitate a number of useful studies of the effect of the zeolite framework in ground and excited state properties. 1 ref.

22677 **(DOE/ER/13623—2) Experimental and theoretical studies of dense fluid mixtures: Scientific and technical progress report, 1 September 1986--28 September 1989.** Zollweg, J.A. (Cornell Univ., Ithaca, NY (USA)). Feb 1989. Contract FG02-86ER13623. 4p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008882/JAW.

Experimental measurements of thermodynamic properties for pure fluids using equipment which we constructed have been carried out. The direct-weighing densimeter contains a pressure vessel which hangs in an oven from a high-capacity precision digital balance. It is capable of measurements at pressures to 200 MPa. The speed-of-sound apparatus is capable of measurements to 400 MPa using the pulse-echo-overlap technique. Equation of state calculations, using data which had been obtained earlier, were performed.

22678 **(HCR-CDM—05) NMR study of some organophosphorus compounds.** Attou, M.; Moriyama, H.; Azzouz, A. (Haut Commissariat a la Recherche, Algiers (Algeria). Centre d'Etudes Nucleaires et Solaires). Dec 1988. 16p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705970/JAW.

Some organophosphorus compounds are studied in the present work. Spectra of these compounds were discussed. /sup 1/ H, /sup 13/C and /sup 31/P NMR methods were used. Some of these organophosphorus compounds were analysed using /sup 17/ O technique. It was observed that TBP, TEP and TMP practically present the same /sup 13/C chemical shift range and in some trialkylphosphates, Karplus effect was notified. The present work allowed to withdraw other important conclusions which can have effective practical applications.

22679 (INIS-BR—1440, pp 18) **Recovery assays of natural zinc targets by electrodeposition for future application in enriched materials.** Santos, D.F. dos; Silva, R.F. da. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22680 (INIS-BR—1440, pp 20) **Survey of calibration curve for measuring the mass of TeO/sub 2/.** Bastos, M.A.V.; Silva, A.G. da. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22681 **(INIS-mf—11913) Structure of cesium hydroxide solutions. Studies by X-ray and neutron-beam diffraction.** Ehrig, R. (Freiburg Univ. (Germany, F.R.). Fakultaet fuer Chemie und Pharmazie). 1982. 130p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88757363/JAW.

By means of the aqueous solution of CsOH the short-range order in a concentrated electrolytic solution is investigated. For a detailed structural analysis of the concentrated CsOH solutions, X-ray and neutron scattering experiments were carried out.

22682 **(LA-UR—89-790) The free energy of formation of $CaCsCl_3$.** Kleinschmidt, P.D.; Axler, K.M. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 22p. (CONF-890435—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009403/JAW.

From 6. international conference on high temperatures: chemistry of inorganic materials; Gaithersburg, MD, USA (3 Apr 1989).

The free energy of formation of the compound $CaCsCl_3$ from $CaCl_2$ and CsCl has been determined by measuring the sublimation pressure of CsCl(g) over $CaCsCl_3$(s) and over CsCl(s) using Knudsen effusion mass spectrometry. The free energy change for the reaction $CaCl_2$(s) + CsCl(s) = $CaCsCl_3$(s) at 298 K is {minus}40.7 +/- 6.4 kJ mol/sup {minus}1/. The enthalpy change is {minus}33.5 +/{minus} 5.2 kJ mol /sup {minus}1/ and the entropy change is 23.4 +/{minus} 3.7 J K/sup {minus}1/ mol/sup {minus}1/. Comparisons are made with determinations of these quantities by other investigators. 15 refs., 2 figs., 6 tabs.

22683 **(NP—9770300) Sorption, separation and conversion of the nuclear spin isomers of hydrogen and deuterium in zeolites and in the zeolite constituents aluminium oxide and silica gel.** Peters, G. (Hamburg Univ. (Germany, F.R.). Fachbereich 13 - Chemie). 19 Oct 1987. 133p. (In German). NTIS (US Sales Only), PC A07. Order Number DE89770300/JAW.

By means of gas chromatographic methods this study investigates the adsorption process as a precondition for a possible separation of the nuclear spin isomers of hydrogen and also the causes for and active centres of conversion. Parallel to infrared spectroscopic measurements and theoretical calculations the study focuses on the forms of sodium and calcium exchange of the A-zeolite. The quantitative analysis of the sorption behaviour of hydrogen and deuterium in microporous systems furnished the clear proof from isothermal chromatograms as well as from desorption measurements that there are several sorption species of different energy and divergent kinetic behaviour. In accordance with statistical-thermodynamic calculations three species for Na/sub 4/Ca/sub 4/A can be characterized with certainty: 1. Molecules localized before the calcium ions, describable by the Langmuir model (q/sup st/ = 7-8 kJ/mol), 2. Molecules (q/sup st/ = 4-5 kJ/mol) sorbed before the sodium ions and rotating around the cavity centre and 3. a relatively mobile gas in the channels of the zeolite skeleton with only low sorption heat of 1-2 kJ/mol.

22684 **(NP—9770304) Gas adsorption measurements and catalytic measurements on crystalline silica.** Kruse, H.H. (Kiel Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 1987. 216p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE89770304/JAW.

In the present study, gas adsorption measurements with various silicic acids and silicates partly doped with foreign ions are presented. Besides nitrogen and argon, gaseous hydrocarbons and CO/ sub 2/ were also used. The catalytical decomposition of alcohols into alkene and water was studied on silica surfaces to illustrate possible effects of pore structures. Knowledge of surface conditions could be applied for the classification of the results of these measurements.

22685 **(NP—9770312) Catalytic synthesis of short-chained olefins. Final report.** Loewe, A. (Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Technische Chemie). 20 Jan 1987. 30p. (In German). NTIS (US Sales Only), PC A03. Order Number DE89770312/JAW.

Since zeolitic or acid catalysts, in the conversion of methanol to hydrocarbons, especially olefins, are too much subjected to carbonization, the attempt was made to achieve a conversion by means of a basic mechanism, namely by using MgO. Different catalyst formulations were tested in a microreactor by a method with strong emphasis on analysis (with 3 gas chromatographs). The fact that purely basic catalyst formulations did not carbonize, must be looked upon as the most important result of all tests. Also the proof that solid basic catalysts form short-chain olefins of methanol must be considered as a positive result of the research work. In spite of all efforts however, it was not possible to obtain technically interesting yields.

22686 **(PNL-SA—16105) Vibrational spectra and chemical bonding in phosphazenes.** Friedrich, D.M.; Exarhos, G.J.; Samuels, W.D.; Ferris, K.F.; Hess, N.J.; Altier, D.J.; Loecker, S.P. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1989. Contract AC06-76RL01830. 8p. (CONF-890145—22). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009384/JAW.

From SPIE conference on optics, electro-optics and laser applications in science and engineering: OE/LASE '89; Los Angeles, CA, USA (15 Jan 1989).

The polarity and polarizability {minus}P{double←bond}N and P{minus}X bonds in phosphazenes (NPX_2)/sub n/ are influenced by the structure and effective electronegativities of the ligands (X) attached to the phosphorus atoms. The nature of chemical bonding in phosphazenes is revealed through responses of vibrational spectra to perturbations such as external pressure and solvent-hydrogen bonding, as well as chemical and isotopic substitution of the ligands. Raman spectra of a series of cyclic phosphazenes are used to identify and classify the vibrational modes. Changes in vibrational frequencies and Raman intensities are interpreted in terms of the polarized chemical bonding model suggested by recent calculations. 5 refs., 5 figs.

22687 **(SAND—88-0970C) Raman and NMR studies of hydrous sodium titanates.** Bunker, B.C.; Tallant, D.R.; Peden, C.H.F.; Martinez, S.L.; Turner, G.L. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 12p. (CONF-890449—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89001819/JAW.

From Materials Research Society (MRS) spring meeting; Reno, NV, USA (5 Apr 1989).

Raman and solid state ^{17}O NMR spectroscopies have been used to determine the molecular structure of amorphous hydrous sodium titanate catalyst support materials prepared by hydrolysis of titanium isopropoxide. Three types of oxygens have been identified: oxygens bridging three titanium atoms, oxygens bridging two titaniums, and non-bridging oxygens. Changes in the relative populations of the different oxygen types have been used to help understand the ion- exchange and polymerization properties of hydrous titanates. 11 refs., 4 figs.

22688 **Hydrogen permeation into iron.** Wampler, W.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800). *Journal of Applied Physics;* **65**: No. 10, 4040-4044(15 May 1989).

The permeation of deuterium (D) from the gas phase into solution in iron has been measured using a new method based on ion beam analysis. For bare metal surfaces the D uptake was observed to be limited by matrix diffusion through the bulk. The influence of chemisorbed oxygen on the D uptake rate was examined in detail. Submonolayer coverages of oxygen caused the D uptake to become surface-limited and reduced the D uptake rate by orders of magnitude. The temperature dependence of the surface-limited uptake rate suggests that a molecular precursor state may be involved in the D uptake for oxygen covered surfaces. The evidence indicates that chemisorbed oxygen reduces the D uptake and release rates by blocking sites where D can be chemisorbed on the surface.

22689 **Chemical equilibrium calculations on the molecular-to-nonmolecular transition of shock compressed liquid nitrogen.** Hamilton, D.C.; Ree, F.H. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Chemical Physics;* **90**: No. 9, 4972-4981(1 May 1989).

Chemical equilibrium calculations are reported on the dissociation of shock-compressed liquid nitrogen to infer the monatomic nitrogen--nitrogen potential in the condensed dissociated phase at high temperature. The analysis suggests that two types of interatomic potentials with very different physical characteristics can about equally describe experimental shock-wave data. The two differ in the interatomic potential parameter α, characterizing the stiffness of the exponential repulsion, and the parameter ϵ which scales the repulsive and attractive interactions. The first type, with a large α and a small ϵ, produces a continuous shock dissociation without thermodynamic phase change, and the second, with a small α and a large ϵ, predicts that the shock dissociation can accompany a first-order phase change. The predicted first-order phase change is new and similar to a theoretically predicted plasma phase transition. The calculation suggests that the transition in nitrogen at high compression may be associated with a physical change at the atomistic level from a van der Waals-type to a much stronger (metallic, semimetallic, or covalentlike) interaction. The implications in interpreting shock-wave data and possible future experiments to distinguish the two potentials are also discussed.

22690 **Comment on "Study on the liquid--vapor interface of water. I. Simulation results of thermodynamic properties and orientational structure".** Wilson, M.A.; Pohorille, A.; Pratt, L.R. (Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **90**: No. 9, 5211-5213(1 May 1989).

This comment on the article by Matsumoto and Kataoka [J. Chem. Phys. 88, 3233 (1988)] identifies a discrepancy between recent calculations of the surface potential of the water liquid–vapor interface. The cited work assumes that the field of a water molecule in the interfacial region is strictly the field of a point molecular dipole, whereas other works have made more detailed assumptions about the molecular charge distributions. The difference between the values for the surface potential obtained from these different assumptions is large compared to the surface potential value in question. It is shown that the numerical difference is associated with the densities of molecular quadrupole moment in the coexisting bulk phases. The correction can be evaluated analytically and applied to the molecular dynamics results after the fact.

22691 **Measurement of the perpendicular rotation-tunneling spectrum of the water dimer by tunable far infrared laser spectroscopy in a planar supersonic jet.** Busarow, K.L.; Cohen, R.C.; Blake, G.A.; Laughlin, K.B.; Lee, Y.T.; Saykally, R.J. (Department of Chemistry and Materials and Chemical Sciences Division, University of California and Lawrence Berkeley Laboratories, Berkeley, California 94720). *Journal of Chemical Physics;* **90**: No. 8, 3937-3943(15 Apr 1989).

Fifty-six transitions from the K = 1 lower→K = 2 lower tunneling--rotation band of water dimer have been measured and

assigned at 22 cm^{-1} by direct absorption spectroscopy in a cw planar supersonic jet expansion using a tunable far infrared laser spectrometer. Two different models were used to fit the data and several spectroscopic constants were determined for the upper and lower states. This work supports the local IAM model recently proposed by Coudert and Hougen for the hydrogen bond tunneling dynamics of the water dimer. This model includes four different tunneling motions, all of which contribute to the observed tunneling splittings. This is the most complicated hydrogen bonded system considered to be well understood at this time, at least in the lowest few K states.

22692 **Phase equilibrium in a special class of polydisperse fluid models.** Kincaid, J.M.; Azadi, M.; Fescos, G.; Pellizzi, L.; Shon, K.B. (Department of Mechanical Engineering, SUNY at Stony Brook, Stony Brook, New York 11794). *Journal of Chemical Physics;* **90**: No. 8, 4454-4463(15 Apr 1989).

For a special class of polydisperse fluid models we have developed methods for obtaining (numerically) exact solutions to the equilibrium conditions. The models considered are special in the sense that the functional dependence of thermodynamic properties on the mole--fraction distribution density F(I) and microscopic parameter functions is restricted. For example, the pressure may depend only on a single moment of F(I). For our special class of models, we show how the dew/bubble conditions can be given a simple two-dimensional geometric representation, and the dew/bubble conditions are reduced to solving two equations in two unknowns. The solution of the full equilibrium conditions can be obtained by an iterative procedure given the solutions of the dew/bubble equations. Three specific models, based on the van der Waals and Soave--Redlich--Kwong equations of state, are examined in detail. We also show how to implement these new solution techniques when the mixture contains a finite number of chemical species.

22693 **Thermal kinetics in small systems.** Klots, C.E. (Chemical Physics Section, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6125). *Journal of Chemical Physics;* **90**: No. 8, 4470-4472(15 Apr 1989).

Standard microcanonical rate-constant theory can be cast in a form which closely resembles and, in the case of a sufficiently large medium, reduces to that of the canonical ensemble. This relation permits a new understanding of the role of an activation energy in a chemical reaction. A facile methodology is also proposed for the extraction of thermodynamic data from kinetic studies of small media.

22694 **Fluorescence investigation of the chromatographic interactions of nitrogen heterocycles with deactivated silica.** Burrell, G.J.; Hurtubise, R.J. (Univ. of Wyoming, Laramie (USA)). *Analytical Chemistry;* **60**: No. 20, 2178-2182(15 Oct 1988). Contract FG02-86ER13547.

Solid-surface fluorescence spectroscopy was used to study the chromatographic interactions of benzo[f]quinoline (B[f]Q) and benzo[h]quinoline (B[h]Q) with water-deactivated silica gel. The results indicated that some of the water was adsorbed on sites in silica that were incapable of proton donation to B[h]Q in the excited singlet state. It was also found that solute localization became more important on the water-deactivated silica. By combination of the luminescence data and the chromatographic data, the mass balance was calculated for three B[h]Q species responsible for the chromatographic bands. Spectral evidence was also obtained that supported a displacement-type of chromatographic mechanism for the systems investigated.

22695 **Electron spin echo envelope modulation studies of natural abundance carbon-13 and aluminum-27 in two disordered systems.** Snetsinger, P.A.; Cornelius, J.B.; Clarkson, R.B.; Bowman, M.K.; Belford, R.L. (Univ. of Illinois, Urbana (USA)). *Journal of Physical Chemistry;* **92**: No. 13, 3696-3698(30 Jun 1988). Contract W-31-109-ENG-38.

Electron spin echo envelope modulation (ESEEM) of stimulated echoes in two different systems--an Illinois No. 6 whole coal and a perylene radical ion adsorbed on alumina powder--reveals matrix interactions from natural abundance low-moment nuclei. Attributing a component of the ESEEM to C-13 in the coal sample and to Al-27 nuclei in the alumina, simulations of the modulations yield values for the hyperfine coupling (a/sub iso/ = 0.4 or 0.01 MHz), the interaction distance (r = 3.05 or 3.3 Angstrom), and the number of interacting nuclei (n $\approx$ 1). These values, being quite different than those obtained from the simulation of the proton matrix peaks, provide complementary information about the environments of the radicals.

22696 **^{13}C hyperfine constants of allyl radical.** McManus, H.J.; Fessenden, R.W.; Chipman, D.M. (Univ. of Notre Dame, IN (USA)). *Journal of Physical Chemistry;* **92**: No. 13, 3778-3781(30 Jun 1988).

The ^{13}C isotropic hyperfine constants of the allyl radical have been measured by in situ radiolysis ESR experiments carried out on aqueous solutions of propene that was labeled at either the 1- or 2-position. The values are 21.93 and 17.21 G for the end and center carbons, respectively. Ab initio calculations have been used to calculate the equilibrium geometry and ^1H and ^{13}C isotropic and anisotropic hyperfine constants. The calculated isotropic hfc are in reasonable agreement with the experimental values. Values calculated from the Karplus-Fraenkel equation with standard values of the Q parameters are also in accord with the experimental values.

22697 **Accurate measurement of vibrational transition energies for a wide range of v, J states using CARS spectroscopy of chemical reaction products: spectroscopy of H_2 from the H + HI reaction.** Germann, G.J.; Valentini, J.J. (Univ. of California, Irvine (USA)). *Journal of Physical Chemistry;* **92**: No. 13, 3792-3795(30 Jun 1988).

Q/sub v/(J) transition energies of H_2 are measured for v = 0-4, J = 0-18 by coherent anti-Stokes Raman scattering (CARS) spectroscopy of rovibrationally excited H_2 from the H + HI $\rightarrow$ H_2 + I reaction at high collision energies. The accuracy of the measurements reported here is 0.05 cm^{-1}, limited by the bandwidth of the laser sources used. The measured transition energies generally agree with those predicted by ab initio quantum calculations and with previous less precise measurements based on H_2 electronic spectroscopy. However, discrepancies outside mutual uncertainties are common, and the accuracy of the ab initio calculations appears to be somewhat less than the 0.015 cm^{-1} claimed. Measurements with an accuracy of 0.0005 cm^{-1}, much greater than that of the present measurements, are possible with the methods described here by using narrow-bandwidth laser sources for CARS spectroscopy.

22698 **Excitation-transfer studies of $N_2(A^3\Sigma/sub\ u/^+)$ with Cd atoms.** Richards, D.S.; Setser, D.W. (Kansas State Univ., Manhattan (USA)). *Journal of Physical Chemistry;* **92**: No. 13, 3821-3828(30 Jun 1988). Contract W-7405-ENG-48.

The excitation-transfer reaction between $N_2(A^3\Sigma/sub\ u/^+,v=0,1)$ and Cd atoms has been studied in a fast flow reactor at 300 K. The total quenching rate constants are (7.7 +/- 3.0) x 10^{-10} and (6.1 +/- 1.4) x 10^{-10} atom^{-1} cm^3 s^{-1} for the v = 0 and v = 1 states of $N_2(A^3\Sigma/sub\ u/^+)$, respectively. Excitation rate constants for formation of $Cd(5^3P_1)$, $Cd(5^3P/sub\ 0,2/)$, $Cd(5^1P_1)$, and $Cd(6^3S_1)$ from the v = 0 and v = 1 states of $N_2(A^3\Sigma/sub\ u/^+)$ also have been determined. The kinetics of the $N_2(A^3\Sigma/sub\ u/^+)$ + Cd system have been examined, paying particular attention to the role of intermultiplet mixing of the $Cd(^3P/sub\ 0,1,2/)$ states. The similarities between the Cd and Hg systems with $N_2(A)$ are discussed. Preliminary experiments suggest that the $CO(a^3II)$ + Cd reaction resembles the $N_2(A)$ + Cd excitation-transfer system.

22699 **Kinetic isotope effects in the gas-phase reaction of hydroxyl radicals with ethylene in the temperature range 343-1173 K and at 1-atm pressure.** Liu, A.; Mulac, W.A.; Jonah, C.D. (Argonne National Lab., IL (USA)). *Journal of Physical Chemistry;* **92**: No. 13, 3828-3833(30 Jun 1988). Contract W-31-109-ENG-38.

The rates of the reaction of ethylene and ethylene-d_4 with OH and OD were determined. The following reactions were examined: OH + C_2H_4 $\rightarrow$ products (HH); OD + C_2H_4 $\rightarrow$ products (DH); OH + C_2D_4 $\rightarrow$ products (HD); OD + C_2D_4 $\rightarrow$ products (DD). These reactions show different reaction pathways at different

temperatures. Below 560 K there is a weak negative activation energy which is characteristic of the OH addition to the double bond. k/sub HH/ and K/sub HD/ were the same at 1.65 x 10^{-12} exp(480/T) cm^3/(molecule s) while k/sub DD/ and k/sub DH/ were the same at 1.35 x 10^{12} exp(480/T) cm^3/(molecule s). Above 720 K, all rate constants show a positive activation energy of 4-5 kcal/mol and both primary and secondary kinetic isotope effects were observed. The high-temperature pathway was attributed to the H abstraction from ethylene by the OH. A conventional transition-state-theory calculation (TST) successfully reproduced the temperature and isotope dependence of the H abstraction rate constants.

22700 **Comparison of the optoacoustic and Hg tracer methods for the study of energy-transfer processes in gas mixtures.** Wallington, T.J.; Braun, W.; Beck, K.M.; Gordon, R.J. (National Bureau of Standards, Gaithersburg, MD (USA)). *Journal of Physical Chemistry;* **92**: No. 13, 3839-3842(30 Jun 1988).

Rates of energy transfer from vibrationally excited SF_6 and pentafluorobenzene to argon in the gas phase have been studied by using the Hg tracer technique and time-resolved optoacoustics. These two techniques which rely on fundamentally different physical principles were found to give equivalent results. The implications for the study of energy-transfer processes in gas mixtures are discussed.

22701 **Rate constant for the reaction of H with H_2O and OH with H_2 by the flash photolysis-shock tube technique over the temperature range 1246-2297 K.** Michael, J.V.; Sutherland, J.W. (Brookhaven National Lab., Upton, NY (USA)). *Journal of Physical Chemistry;* **92**: No. 13, 3853-3857(30 Jun 1988). Contract AC02-76CH00016.

Rate constants for the reaction of atomic hydrogen with water, reaction 1, were measured by the flash photolysis-shock tube technique utilizing atomic resonance absorption to monitor the change in H atom concentrations with time. Experiments were carried out over the temperature range 1246-2297 K, and the results can be expressed by the Arrhenius equation $k_1(T) = (4.58 +/- 0.61) \times 10^{-10} \exp[(-22966 +/- 482 \text{ cal mol}^{-1})/RT] \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$. The errors are given at the one standard deviation level. By use of the known values of the equilibrium constant, $K_1(T)$, for reaction 1, each experimental $k_1(T)$ measurement was converted to its corresponding value of the rate constant of the reverse reaction, k/sub -1/(T). Over the temperature range 1246-2297 K, the k/sub -1/(T) results can be expressed by the Arrhenius equation k/sub -1/(T) = $(1.05 +/- 0.17) \times 10^{-10} \exp[(-8037 +/- 482 \text{ cal mol}^{-1})/RT] \text{ cm}^3$ $\text{molecule}^{-1} \text{ s}^{-1}$. A composite data base for k/sub -1/(T) was constructed for the temperature range 250-2581 K from the present results and selected previously published data. The resulting Arrhenius plot is nonlinear and may be fitted by the three-parameter expression k/sub -1/(T) = 3.59 x 10^{-16}T/sup 1.51/ exp(-1726 K/T) cm^3 molecule^{-1} s^{-1}. These results are compared to earlier experimental measurements and to recently reported theoretical calculations.

22702 **Bonding of osmium carbonyls to magnesia: evidence from ^{13}C NMR spectroscopy.** Hasselbring, L.; Puga, J.; Dybowski, C.; Gates, B.C. (Univ. of Delaware, Newark (USA)). *Journal of Physical Chemistry;* **92**: No. 13, 3934-3936(30 Jun 1988). Contract FG05-85ER75214.

The interactions of $[H_2Os(CO)_4]$ and of $[H_4Os_4(CO)_{12}]$ with the basic MgO support have been examined by CP/MAS ^{13}C NMR spectroscopy in conjunction with infrared spectroscopy and extraction experiments. Comparison of the spectra of the surface species with those of model compounds, in solution and in the solid state, indicates a strong localized absorbate-support interaction of the mononuclear complex $[HOs(CO)_4]^-$ to a surface Mg^{2+} ion through the oxygen of a carbonyl ligand, whereas there is a weak ionic association of the large tetranuclear anion $[H_3Os_4(CO)_{12}]\vee$ with the surface.

22703 **Nuclear magnetic resonance of xenon occluded in Na-A zeolite.** Samant, M.G.; de Menorval, L.C.; Dalla Betta, R.A.; Boudart, M. (Stanford Univ., CA (USA)). *Journal of Physical Chemistry;* **92**: No. 13, 3937-3938(30 Jun 1988). Contract FG22-83PC60782.

Xenon was forced into the α-cages of a Na-A zeolite at 40 bar and 525 K with up to 1.8 atoms per cage. After cooling to room temperature and releasing pressure, the ^{129}Xe NMR spectrum taken in air shows five peaks assigned to as many Xe atoms in the cages. Following exposure of the sample to water, the five peaks are replaced by a single one corresponding to a xenon-water clathrate. This work presents an additional application of xenon NMR toward the study of microporosity of solids.

22704 **Molecular structure of benzene coadsorbed with CO on Pd(111): a dynamical low-energy electron diffraction analysis.** Ohtani, H.; Van Hove, M.A.; Somorjai, G.A. (Lawrence Berkeley Lab., CA (USA)). *Journal of Physical Chemistry;* **92**: No. 13, 3974-3982(30 Jun 1988). Contract AC03-76SF00098.

The molecular structure of the ordered (3 x 3) superlattice of coadsorbed C_6H_6 and CO on the Pd(111) crystal face is analyzed by dynamical calculations of low-energy electron diffraction intensities. The benzene molecules are found to be oriented with their carbon rings parallel to the surface, centered over fcc-type 3-fold hollow sites. The C-C bond lengths in the benzene ring skeleton are found to be either 1.40 +/- 0.10 or 1.46 +/- 0.10 Angstrom depending on the position of the C-C bonds relative to the underlying Pd atoms. These bond lengths are very close to the corresponding gas-phase value of 1.397 Angstrom. This contrasts with similar coadsorbate systems of benzene and CO on Rh(111) or Pt(111), where significant in-plane distortions and enlargements of the benzene rings have been detected. A trend toward more distortion and increasing average C-C bond length has been found in changing substrates from Pd to Rh and Pt, while the metal-carbon bond lengths decrease in that same sequence. This is interpreted to indicate that the metal-carbon bond becomes stronger, while C-C bonds weaken from Pd to Rh and Pt, which is further supported by high-resolution electron energy loss spectroscopic data. Coadsorbed CO molecules are necessary to form an ordered benzene overlayer on Pd(111). They occupy fcc-hollow sites surrounding the benzene molecules. The C-O axis is perpendicular to the surface, and the carbon-oxygen and palladium-carbon bond lengths are found to be 1.17 +/- 0.05 and 2.05 +/- 0.04 Angstrom, respectively.

22705 **Enthalpy of immersion of a microporous solid.** Jaroniec, M.; Madey, R. (Kent State Univ., OH (USA)). *Journal of Physical Chemistry;* **92**: No. 13, 3986-3988(30 Jun 1988).

Presented here is a general relationship between the enthalpy of immersion of a microporous solid in a liquid and the average adsorption potential. Special cases of this relationship are discussed for uniform as well as nonuniform microporous solids.

22706 **Selected properties of Be clusters in ab initio model approximations.** Ermler, W.C.; Ross, R.B.; Kern, C.W.; Pitzer, R.M.; Winter, N.W. (Stevens Institute of Technology, Hoboken, NJ (USA)). *Journal of Physical Chemistry;* **92**: No. 11, 3042-3046(2 Jun 1988). Contract W-7405-ENG-48.

Results of ab initio self-consistent field calculations are reported for electronic states of beryllium clusters comprised of 13, 19, 21, 33, 39, 51, 57, and 63 atoms. The clusters correspond to the second through ninth coordination shells of a central Be atom with internuclear separations taken from the lattice constants of the bulk hcp metal. Effective core potentials have been employed to replace the 1s core electrons, thereby reducing the complexity of the calculations. In addition, the use of the full D/sub 3h/ point group symmetry of each cluster results in substantial reductions of the number of two-electron integrals that must be computed and processed. Properties are calculated for selected electronic states and include binding energy, orbital energies, electric field gradient, nuclear-electron potential, diamagnetic shielding constant, second moments, and Mulliken populations. Overall net charges, second moments, and nuclear potentials become approximately constant in the larger clusters, indicating bulk behavior.

22707 **Electronic structure analysis of electron-transfer matrix elements for transition-metal redox pairs.** Newton, M.D. (Brookhaven National Lab., Upton, NY (USA)). *Journal of Physical Chemistry;* **92**: No. 11, 3049-3056(2 Jun 1988). Contract AC02-76CH00016.

Calculated electron-transfer matrix elements (H/sub if/) for redox processes of the type $ML_6^{2+} + ML_6^{3+}$ reversible $ML_6^{3+} + ML_6^{2+}$ (M = Fe, Co, or Ru; L = H_2O or NH_3 have been analyzed in terms of various orbital concepts. The matrix elements are based on ab initio wave functions for model supermolecule clusters of the type (ML/sub n/ ...L/sub n/M)$^{5+}$, with n = 1 or 3. The many-electron H/sub if/ quantities are analyzed as effective one-electron expressions of the type H/sub if/ proportional to $(\lambda')^2$h/sub LlLr//sup c/, where λ' is the metal-ligand covalency parameter and h/sub LlLr//sup c/ is a local one-electron matrix element for ligand orbitals in contact in the transition state. The data for apex-to-apex approach of reactants yield an excellent linear least-squares fit (r^2 = 0.996) and imply a value of ~ 5000 cm^{-1} for h/sub LlLr//sup c/, thus showing that significant coupling can occur in the absence of formal bonding between reactants.

22708 **Electronic-structure methods for heavy-atom molecules.** Pitzer, R.M.; Winter, N.W. (Ohio State Univ., Columbus (USA)). *Journal of Physical Chemistry;* **92**: No. 11, 3061-3063(2 Jun 1988). Contract W-7405-ENG-48.

Methods are derived to simplify and expand the scope of ab initio electronic-structure calculations using relativistic core potentials. The spin-orbit operator obtained at the same level of approximation is expressed in a simpler form to facilitate matrix-element computation. Double-group results are used, when sufficient spatial symmetry is present, both to block the Hamiltonian matrix and to make it real, even though the wave functions are necessarily complex.

22709 **Phase space structure in classically chaotic regions and the nature of quantum eigenstates.** Davis, M.J. (Argonne National Lab., IL (USA)). *Journal of Physical Chemistry;* **92**: No. 11, 3124-3144(2 Jun 1988). Contract W-31-109-ENG-38.

The authors review recent work concerning phase space structure relevant to energy relaxation and chemical reactions. Another example is shown, and that is for the local to normal mode transition in classically chaotic regions. The main purpose of the paper is to investigate the nature of the quantum eigenstates under such a condition, and they investigate what happens to the local and normal mode character of eigenstates when there is widespread chaos and there is extensive exchange of energy between two local modes and local and normal modes classically. They show that the quantum local-normal transition does not change significantly as classical chaos spreads. They relate this to the size of the flux across various phase space structures and present evidence that the quantum mechanics is essentially regular even when chaos is so widespread that, near the dissociation energy, chaotic regions can support approximately 10 quantum states. To further demonstrate this regularity, they quantitize some of the noninvariant phase space structure.

22710 **Dynamics for nonconservative systems: ergodicity beyond the microcanonical ensemble.** Jellinek, J. (Argonne National Lab., IL (USA)). *Journal of Physical Chemistry;* **92**: No. 11, 3163-3173(2 Jun 1988). Contract W-31-109-ENG-38.

A generalization of the procedure suggested recently by Nose for dynamical simulation of a canonical ensemble is presented. It is shown that there are infinitely many different dynamics capable of mimicking the canonical ensemble for a physical system provided the corresponding dynamics for an extended system consisting of the physical system and a bath is ergodic in a particular sense. An invariance property of ergodicity under scaling of the time is established. It is shown how the time scaling can be used to tune the dynamics into ergodicity with respect to any desired distribution function in a given phase space. The dynamics of the extended system implies an apparent trajectory for the physical system which is quite different from the one generated by the Hamiltonian dynamics for a closed physical system. A general unified scheme for dynamical simulation of any statistical mechanical ensemble is formulated.

22711 **Centrifugal sudden distorted wave study of the Cl + HCl → ClH + Cl reaction: results for a scaled fitted ab initio potential energy surface having a noncollinear reaction path.** Schatz, G.C.; Amaee, B.; Connor, J.N.L. (Argonne National Lab., IL (USA)). *Journal of Physical Chemistry;* **92**: No. 11, 3190-3195(2 Jun 1988). Contract W-31-109-ENG-38.

The authors present the results of a centrifugal sudden distorted wave (CSDW) quantum scattering study of the reaction Cl + HCl → ClH + Cl. The potential energy surface used in this calculation (denoted sf-POLCI) has been chosen to fit a scaled ab initio surface for Cl-H-Cl angles greater than 150° (angles for which the latter surface has been determined), and to fit an extended London-Eyring-Polanyi-Sato (LEPS) surface at smaller angles. This sf-POLCI surface has a noncollinear Cl-H-Cl saddle point with a Cl-H-Cl angle of 161.4°. They also compare their CSDW results with those from a LEPS surface, which has a collinear geometry saddle point, but is otherwise similar to the sf-POLCI surface. Results presented include partial wave reaction probabilities, integral and differential cross sections, product rotational distributions, and thermal rate coefficients. The sf-POLCI results are generally similar to the LEPS results, although there are a few important differences. In particular, the integral cross sections in the threshold region increase more slowly with energy for the sf-POLCI surface. As a result, the activation energy is smaller for the LEPS surface, even though is has the higher barrier. Both the sf-POLCI and LEPS cross sections exhibit high product rotational excitation, with the sf-POLCI products more excited than the LEPS. Also, the rotational state which contributes most to the thermal rate coefficient is higher for the sf-POLCI surface than for the LEPS. For both surfaces the CSDW rate coefficients agree with experiment within the experimental uncertainties.

22712 **Comparative analysis of stationary-phase Monte Carlo methods.** Doll, J.D.; Freeman, D.L. (Los Alamos National Lab., NM (USA)). *Journal of Physical Chemistry;* **92**: No. 11, 3278-3280(2 Jun 1988).

The authors consider the stationary-phase Monte Carlo method and a variety of related approaches. The stationary-phase Monte Carlo method is aimed at the generic problem of performing high-dimensional integrations of rapidly oscillatory integrands. Real time numerical path integration is one important class of applications where such problems arise. They examine the relationship between the stationary-phase Monte Carlo approach and the recent work of Makri and Miller and Filinov.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 22264, 22278, 22337, 22541, 22542, 22719

22713 **(BNL—42093) Applications and limitations of in situ current density mapping.** Isaacs, H.S. (Brookhaven National Lab., Upton, NY (USA)). 1989. Contract AC02-76CH00016. 8p. (CONF-890437—6). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006170/JAW.

From Corrosion '89; New Orleans, LA, USA (17 Apr 1989).

The basic equations relevant to the operation of the vibrating prove technique have been presented. The role of the probe height above the surface as it affects the determination of the current densities at the metal surface, the resolution of the anodic or cathodic areas, and the amplitude of the probe vibration have been analyzed and discussed. The analysis incorporates the lock-in amplifier operation in determining the effects of nonuniform fields on the observation for a point current source. The approaches have been applied to the corrosion behavior of iron in a dilute chloride and sulfate solution. 7 refs., 4 figs.

22714 (CANMET—86-8F) An electrochemical analysis of solid electrolyte/electrodes systems. Canaday, J.D.; Kuriakose, A.K.; Ahmad, A.; Wheat, T.A. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). 1986. 38p. (In French). (MICROLOG—88-04565). Canada Centre for Mineral and Energy Technology, Technical Information Division, 555 Booth St., Rm. 342, Ottawa, Ont., Canada K1A 0G1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A three-phase electrochemical cell consisting of reactant gases, porous electrodes, and a solid electrolyte is described in electrochemical terms. Electrode processes that cause polarization phenomena are also discussed. Comparisons are also made to two-phase cells, with liquid and solid electrodes. Two-probe techniques are shown to be indispensable for evaluating the thermodynamic properties of a cell. This technique was also found useful for measuring the total yield of the cell since the separation of the anodic, cathodic, and electrolytic polarization factors is not required. The three-probe technique was found necessary for measuring kinetic properties. The application of these 2- and 3-probe methods has permitted the determination of the fundamental values of cells of the 3-phase ion-oxygen type and the protonic solid electrolyte type. 56 refs., 3 figs., 15 tabs.

22715 (LBL—26134) Exploratory cell research and fundamental processes study in solid state electrochemical cells: Final report. Smyrl, W.H.; Owens, B.B.; White, H.S. (Lawrence Berkeley Lab., CA (USA); Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). Oct 1988. Contract AC03-76SF00098. 114p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008849/JAW.

Effort was focused on 3 major areas: Exploratory Cell Research,Fundamental Studies of Reaction and Transport in Polymeric Electrolytes, and Voltammetry Studies using Microstructured Electrodes. Work includes design, fabrication and application. 38 figs., 7 tabs.

22716 Electrochemistry and spectroelectrochemistry of nitroxyl free radicals. Fish, J.R.; Swarts, S.G.; Sevilla, M.D.; Malinski, T. (Oakland Univ., Rochester, MI (USA)). *Journal of Physical Chemistry;* **92**: No. 13, 3745-3751(30 Jun 1988).

This work reports electrochemical and spectroelectrochemical studies of the two nitroxyl radicals 2,2,6,6-tetramethyl-1-piperidinyloxy (TEMPO) and 3-carbamoyl-2,2,5,5-tetramethyl-3-pyrrolin-1-yloxy (3-carbamoyl-PROXYL). Oxidation and reduction reactions have been observed in aqueous media over the pH range 2-12 in the potential range -0.8 to +0.8 V by differential pulse voltammetry, cyclic voltammetry, and thin-layer UV-visible spectroelectrochemistry, and the reaction products have been characterized by IR, NMR, and ESR spectrometry. At pH values less than 10, characteristic electrochemical behavior is observed to be analogous for both radicals, and the products from electron transfer compare quite favorably with those found by pulse radiolysis of aqueous solutions of nitroxyl radicals. At pH 2-9, a stable cation from a reversible oxidation and hydroxylamine following an irreversible reduction, as well as hydroxylated cation at pH higher than 9, are the same as those obtained in pulse radiolysis experiments. Spectroscopic evidence indicates that behavior following reduction at high pH differs for the two radicals. At pH 12, reduced TEMPO may undergo structural changes leading to the formation of a new radical consisting of a seven-membered ring.

4005 Photochemistry

REFER ALSO TO CITATION(S) 22842

22717 (DOE/ER/45107—12) Triplet photophysics of polystyrene with and without selected terminating substituents. Burkhart, R.D.; Burrows, J.A.J.; Haggquist, G.W. (Nevada Univ., Reno (USA). Dept. of Chemistry). 1989. Contract FG08-84ER45107. 7p. (CONF-890145—24). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009316/JAW.

From SPIE conference on optics, electro-optics and laser applications in science and engineering: OE/LASE '89; Los Angeles, CA, USA (15 Jan 1989).

Polystyrene molecules selectively terminated with an acetophenone-like (AC) group at one end and a naphthyl group at the opposite end have been prepared and their triplet photophysics investigated. Photoexcitation of solid films of these polymers using a nitrogen laser (337 nm) yields phosphorescence bands attributable to the AC group and the naphthalene group. Using 337 nm excitation and viewing the emission at 0.1 msec after the excitation pulse, a broad phosphorescence band overlaps the AC signal. At longer delay times the typical structured AC emissions emerges if the sample temperature is at 77 K but at ambient temperature the broad band persists. Apparently the AC emission is inhomogeneously broadened with an inhomogeneous band width large enough so that spectral diffusion can occur at 77 K. Luminescence decay kinetics provide information about possible modes of energy transfer from initially excited AC species to the naphthyl group. 6 refs., 3 figs.

22718 Proton production in one- and two-color laser ionization and dissociation of molecular hydrogen. Buck, J.D.; Parker, D.H.; Chandler, D.W. (Univ. of California, Santa Cruz (USA)). *Journal of Physical Chemistry;* **92**: No. 13, 3701-3705(30 Jun 1988).

Production pathways for H^+ following multiphoton excitation of H_2 are explored by using the E,F excited electronic state as a two-photon-resonant intermediate level. In one-laser experiments H^+ is formed by dissociation of the neutral molecule rather than by dissociation of the H_2^+ ion. By use of time-delayed double-resonance laser ionization, three distinct processes for H^+ formation are identified. In each case the observed threshold for dissociation from the chosen resonant level lies surprisingly close to an asymptotic (R/sub H(1s)+H*/ → infinity) limit.

22719 Gallium phosphide/gallium arsenide phosphide strained-layer superlattice electrodes. Effect of the terminating layer on photoelectrochemical properties. Zuhoski, S.P.; Johnson, P.B.; Ellis, A.B.; Biefeld, R.M.; Ginley, D.S. (Univ. of Wisconsin, Madison (USA)). *Journal of Physical Chemistry;* **92**: No. 13, 3961-3965(30 Jun 1988). Contract AC04-76DP00789.

Pairs of strained-layer superlattices (SLS's) have been studied as photoanodes in photoelectrochemical cells (PEC's) employing aqueous ditelluride electrolyte. The SLS's are comprised of alternating layers of n-GaP and a n-GaAs/sub 1-x/P/sub x/ alloy (x ~ 0.6) with a total of 25 periods; the pairs are grown under matched conditions with one member terminating in the alloy composition and its counterpart in GaP. The pairs possess common bulk properties but different surfaces. While all samples examined gave good efficiencies for the conversion of 458- and 514-nm ultraband gap (E/sub g/ ~ 2.1 eV) monochromatic light to electricity (in some cases ~ 10%), the alloy-terminated samples gave consistently better efficiencies. Bulk and surface properties that may contribute to the superiority of the alloy-terminated samples are discussed. Photoaction spectra reveal the GaP-terminated samples to have an enhanced photoresponse near the band gap energy. Evidence that this feature is surface-localized is presented. Attempts to modulate the photoelectrochemical properties of a given SLS electrode by removing its original terminating layer are discussed.

22720 Photoionization of chlorophyll a in vesicles: effects of variation of the alkyl chain length of the phospholipid. Hiff, T.; Kevan, L. (Univ. of Houston, TX (USA)). *Journal of Physical Chemistry;* **92**: No. 13, 3982-3985(30 Jun 1988).

Electron spin resonance has been used to detect the products of photoionized chlorophyll a by red light with or without electron scavengers and to measure their yields in vesicles differing by the alkyl chain length (C_{14} to C_{18}) of the phospholipid. Electron spin echo (ESE) spectroscopy has been used to investigate the solubilization sites of photogenerated chlorophyll a cation and tetrabromobenzoquinone anion in these different vesicles. As the alkyl chain length of the phospholipid decreases, the photoionization yield increases. This indicates that the average electron-transfer distance from photoexcited chlorophyll a decreases as the surfactant alkyl chain length decreases. In addition, the ESE of the quinone anion

shows an increase in the deuterium modulation depth from D_2O at the vesicle surface when the surfactant alkyl chain length decreases.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 22136

22721 **(PNL-SA—15797) The importance of variables and parameters in radiolytic chemical kinetics modeling.** Piepho, M.G.; Turner, P.J.; Reimus, P.W. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1988. Contract AC06-76RL01830. 9p. (CONF-881066—7). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008252/JAW.

From 12. international symposium on the scientific basis for nuclear waste management; Berlin, F.R. Germany (10 Oct 1988).

Many pertinent radiochemical reactions are not completely understood, and most of the associated rate constants are poorly characterized. To help identify the important radiochemical reactions, rate constants, species, and environmental conditions, an importance theory code, SWATS (Sensitivity With Adjoint Theory-Sparse version)-LOOPCHEM, has been developed for the radiolytic chemical kinetics model in the radiolysis code LOOPCHEM. The LOOPCHEM code calculates the concentrations of various species in a radiolytic field over time. The SWATS-LOOPCHEM code efficiently calculates: (1) the importance (relative to a defined response of interest) of each species concentration over time, (2) the sensitivity of each parameter of interest, and (3) the importance of each equation in the radiolysis model. The calculated results will be used to guide future experimental and modeling work for determining the importance of radiolysis on waste package performance. A demonstration (the importance of selected concentrations and the sensitivities of selected parameters) of the SWATS-LOOPCHEM code is provided for illustrative purposes, and no attempt is made at this time to interpret the results for waste package performance assessment purposes. 12 refs., 1 fig., 1 tab.

22722 **Relaxation dynamics following transition of solvated electrons.** Barnett, R.B.; Landman, U.; Nitzan, A. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *Journal of Chemical Physics;* **90**: No. 8, 4413-4422(15 Apr 1989).

Relaxation dynamics following an electronic transition of an excess solvated electron in clusters and in bulk water is studied using an adiabatic simulation method. In this method the solvent evolves classically and the electron is constrained to a specified state. The coupling between the solvent and the excess electron is evaluated via the quantum expectation value of the electron--water molecule interaction potential. The relaxation following excitation (or deexcitation) is characterized by two time scales: (i) a very fast ({similar←to}20--30 fs) one associated with molecular rotations in the first solvation shell about the electron, and (ii) a slower stage ({similar←to}200 fs), which is of the order of the longitudinal dielectric relaxation time. The fast relaxation stage exhibits an isotope effect. The spectroscopical consequences of the relaxation dynamics are discussed.

22723 **^{13}C hyperfine constants of H_2CN, H(HO)CN, and $CONH_2$.** McManus, H.J.; Fessenden, R.W.; Chipman, D.M. (Univ. of Notre Dame, IN (USA)). *Journal of Physical Chemistry;* **92**: No. 13, 3781-3784(30 Jun 1988).

The ^{13}C hyperfine constants of the radicals $H_2CN^{\bullet}$, $H(HO)CN^{\bullet}$, and $^{\bullet}CONH_2$ derived from ^{13}C-enriched CN^- have been measured in aqueous solution by ESR experiments using in situ radiolysis. The values found are 28.9, 20.5, and 158.4 G, respectively. Detailed ab initio calculations were also performed on these species, showing each of the radicals to be planar and yielding calculated hyperfine constants that are in reasonable agreement with the observed ones. The calculations show a large decrease in the CH proton hyperfine constant from $H_2CN^{\bullet}$ to $H(HO)CN^{\bullet}$ paralleling that found experimentally. No significant geometry change is required to explain this effect. The large ^{13}C hyperfine constant of 158 G found for $^{\bullet}CONH_2$ demonstrates the σ nature of this radical.

22724 **^{13}C hyperfine interactions in terephthalate trianion radical.** Qin, L.; Madden, K.P.; Schuler, R.H. (Univ. of Notre Dame, IN (USA)). *Journal of Physical Chemistry;* **92**: No. 13, 3790-3792(30 Jun 1988).

Sufficiently high concentrations of terephthalate radical trianion can be produced by reduction of terephthalate with acetone ketyl radical anion in in situ radiolysis experiments that ESR spectra of the radicals containing ^{13}C at natural abundance levels can be recorded readily. The ^{13}C hyperfine constant for the carbon atoms at the four equivalent ring positions is (-) 1.46 G. Hyperfine constants of 1.37 and 4.64 G are observed for the other two pairs of equivalent carbon atoms with the smaller value found to apply to the carboxyl carbons from studies of a sample with the carboxyl group enriched in ^{13}C. Application of the Karplus-Fraenkel relation indicates that there is an unpaired spin population of $\sim$ 0.26 on each of the ring carbon atoms adjacent to the carboxyl groups. The high-spin population is reflected in somewhat broadened lines of the radicals with ^{13}C at these ring positions. The signals of this radical saturate relatively easily, indicating a longitudinal relaxation period considerably longer than for most transient radicals.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 23552

22725 **(BARC—1423) Radiochemistry Division annual progress report: 1986.** Datta, T. (ed.) (Bhabha Atomic Research Centre, Bombay (India). Radiochemistry Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1988. 146p. NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS. Order Number DE88706139/JAW.

Research and Development (R and D) activities of the Radiochemistry Division of Bhabha Atomic Research Centre, Bombay during 1986 are reported. Some of the highlights of these activities are solvent extraction studies on U(VI) and trivalent Am, Cm and Cf, low energy and medium energy fission of actinides, nuclear reactions on /sup 197/Au, perturbed angular correlation studies on polymerisation of Hf(IV) and EPR studies on Am doped BaCO/sub 3/, SrSO/sub 4/ and LiKSO/sub 4/. Investigations on the complexation, hydrolysis and speciation of Am(III) in phosphate and carbonate media have been carried out with a view to understanding the behaviour of Am ions in natural and waste water systems. The angular momentum studies have shown that fission fragment angular momentum increases with increasing excitation energy and angular momentum of the fissioning due to coupling of various collective rotational degrees of freedom. Angular distribution studies have shown that asymmetric mode fragments have higher anisotropy compared to the symmetric mode fragments due to extended saddle point shape and hence larger effective moment of inertia. Studies on alpha induced nuclear reaction on /sup 197/Au have provided evidence for non-equilibrium particle emission process as against the expected compound nucleus mechanism. EPR and TSL studies on actinide doped solids have shown stabilisation of radicals produced on irradiations as well as provided evidence for chemically induced dynamic nuclear polarization. At the end of the report, a list of publications of the staff members of the Division during the report is given. These publications include journal articles, conference paper and technical reports.

22726 **(CEA-tr—2290) Technetium compounds and their field of application.** Zaitseva, L.L.; Velichko, A.V.; Vinogradov, I.V. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Feb 1988. 106p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88757186/JAW.

This chapter reviews the different applications of technetium and technetium compounds in catalysis, corrosion inhibition, superconductivity of technetium alloys, diagnostic techniques, radioisotope generators and radiopharmaceuticals. 649 refs.

22727 (INIS-BR—1440, pp 16) **Improvements of /sup 67/Ga//sup 65/Zn chemical separation.** Santos, D.F. dos; Silva, R.F. da. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22728 (INIS-BR—1440, pp 22) **New method for /sup 22/Na production without carrier addition and free of residue.** Britto, J.L.Q. de; Bastos, M.A.V.; Silva, R.F. da; Silva, A.G. da. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22729 (INIS-BR—1440, pp 25) **Production of calibration sources for X-ray detectors: /sup 55/Fe, /sup 57/Co and /sup 109/ Cd.** Osso Junior, J.A.; Silva, R.F. da; Souza, J.C. de. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22730 (INIS-BR—1440, pp 30) **Production of a Sn tracer.** Osso Junior, J.A.; Braghirolli, A.M.S.; Silva, R.F. da. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22731 (INIS-BR—1440, pp 70) **Radioisotope microbiological control.** Aleixo, L.C.M. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22732 **(JET-R—88-18) Experimental contamination and decontamination studies on JET remote handling tools and materials when exposed to tritium.** Tesini, A.; Jalbert, R.A. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking; Los Alamos National Lab., NM (USA)). (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). 1988. 84p. NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88706093/JAW.

Tests were performed to investigate the tritium release processes occuring when using Remote Handling tools on tritium contaminated INCONEL 600 material. Tritium surface contamination of these tools after operation on tritium contaminated material and following exposure to HTO was also investigated. One Remote Handling tool, in particular, was decontaminated using high temperature technique. Additional tests were performed to evaluate the degree of contamination of materials including INCONEL 600, Aluminium alloy, PVC rigid and Stainless steel 316 and 304 exposed to tritium gas and/or tritiated water. Exposure time and temperature of exposure, post exposure off-gassing time and tritium concentration were varied during the experiments. The effectiveness of various decontamination techniques on materials exposed for different periods of time was also assessed.

22733 **(JINR—12-88-178) Formation of EDTA complexes of astatine.** Milesz, S.; Jovchev, M.; Schumann, D.; Khalkin, V.A.; Milanov, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1988. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706220/JAW.

Submitted to the journal J. Radioanal. Nucl. Chem. Lett. .

Using the electromigration method a monopositive astatine ion has been shown to form AtL/sup 3-/ complexes with EDTA (H/sub 4/L) in 0.1 mol.dm/sup -3/ NaClO/sub 4/ solution at pH=3-10. The ion mobility of AtL/sup 3-/ complex has been determined to be 5.60(23) 10/sup -4/ cm/sup 2/V/sup -1/ s/sup -1/ at 298 K. In the range pH 3-10 in the absence of EDTA no mobility of astatine anionic forms is shown. 17 refs.; 1 fig.; 1 tab.

22734 **(JINR-R--6-88-201) Is element 104, kurchatovium, a p-element? Relativistic calculations of the electronic atomic structure.** Glebov, V.A.; Nefedov, V.S.; Kastura, L.; Z hujkov, B.L. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1988. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706253/JAW.

Submitted to the journal Radiochim. Acta.

Relativistic calculations of the electronic structure of the kurchatovium atom were carried out taking 468 jj-configurations into account. It was found that the ground state of Ku should be a J=2 level consisting mostly of the 6d7s/sup 2/7p configuration (80%). The nearest level (lying ~ 0.5 eV higher) is the one with J=2, in which the 6d/sup 2/7s/sup 2/ configuration makes up 90%. The 7s/sup 2/7p/sup 2/ configuration lies 2.9 eV above the ground state. It is concluded from the comparison of the orbital energies and multielectron levels of Ku and the atoms of d- and p-elements of group L that, according to its chemical properties, kurchatovium must belong to d-, rather than to p-elements. 11 refs.; 4 figs.; 1 tab.

22735 **(KAERI/RR—604/87) Study on the adsorption characteristics of filtering materials.** Kim, You Sun; Kang, Hee Suk. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Dec 1987. 179p. (In Korean). NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS. Order Number DE88705870/JAW.

A convenient procedure of preparing chemical impregnants of TEDA (Triethylenediamine) and its alkyl derivatives has been searched, and dimethyl iodides of TEDA and TEDA derivatives were prepared in a good yield. These iodides were converted to their diethoxides and thermal decomposition of these ethoxides are being investigated to obtain the corresponding TEDA and TEDA derivatives. Parameters on the impregnation of a base carbon with TEDA + Dimethyl iodide of TEDA or TEDA derivatives were searched, and basic data were obtained. Active carbon samples prepared in this project were examined for their physical properties and performances by means of ASTM D-Series Standards and chemical compositions and deterioration patterns were also checked on basis of analytical methods developed by this laboratory. Experimental results obtained in this research were reviewed and possible measures to implement these research data in this country were also studied.

22736 (KURRI-TR—308, pp 39-42) **Application of labelled compound produced by reactor to medicament.** Kawai, Kenichi. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Sep 1988. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780083/JAW. (CONF-8709418—).

From 8. symposium on the development of advanced technology for scientific research; Kumatori, Japan (24 Sep 1987).

Enriched platinum(mw:194) metals were irradiated in the hydralic conveyer of KUR with a thermalneutron flux of approx. 8.15 x 10/sup 13/ n center dot cm/sup -2/ center dot sec/sup -1/ for 20

hrs. Two days after irradiation, sample were dissolved in aquaregia, and reduced by hydazin to Pt/sup ++/. To synthesize /sup 195m/ Pt-labelled CDDP, NH/sub 4/OH was added to the reaction mixture, and the amination reaction was proceeded under the wild heating condition. The separation and purification of CDDP were carried out using HPLC (Shordex OHpak columm). Present results indicated that the use of HPLC is useful to obtain /sup 195m/Pt-CDDP with the highest chemical and radiochemical purities. The specific-activity of /sup 195m/Pt-CDDP was about 100 μCi/mg-CDDP at the present experimental condition.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 21899, 22662

22737 **(UCRL—100437) Dynamic effects of flame baroclinicity.** Pindera, M.Z. (Lawrence Livermore National Lab., CA (USA)). Feb 1989. Contract W-7405-ENG-48;AC03-76SF00098. 13p. (CONF-870868—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008893/JAW.

From 11. international colloquium on dynamics of explosions and reactive systems; Warsaw, Poland (3 Aug 1987).

Presented herein is a numerical model for combustion of premixed gases in two-dimensional flow-field. The model is used to study some of the effects of flame-induced baroclinicity on the flame and the surrounding fluid. Two examples are chosen to illustrate this. In the steady state case, numerical calculations are compared to an exact analytical solution. The results show that the flame should be regarded as a source of vorticity as well as a source of volume and that flame-induced fluid rotation forms a major component of the resultant flow-field. In the unsteady case, numerical results reveal a new stabilizing phenomenon: baroclinicity has a damping effect on the growth rate of flame-front perturbations. A simple heuristic argument shows why this should be so. 10 refs., 6 figs.

22738 **Measurement and prediction of Raman Q-branch line self-broadening coefficients for CO from 400 to 1500 K.** Rosasco, G.J.; Rahn, L.A.; Hurst, W.S.; Palmer, R.E.; Dohne, S.M. (Center for Basic Standards, U. S. National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of Chemical Physics;* **90**: No. 8, 4059-4068(15 Apr 1989).

The J and temperature dependence of the self-broadening coefficients for the Raman Q-branch lines of pure CO have been experimentally determined for Q(J) transitions with J = 0--38 and for temperatures in the range 400--1500 K. It is shown that a fitting law, based on a modified exponential energy-gap model for the rates of state-to-state rotationally inelastic collisions, can account for the observed J dependence. The two parameters that determine the J dependence are found to be essentially independent of temperature. A temperature scaling function, recently proposed for N_2, is added to the basic rate law, and accurate predictions of both the J and the T dependence of these coefficients and those previously reported at 298 K are obtained. This rate law model, used in conjunction with a relaxation matrix description of the Q-branch spectrum, is shown to give good agreement with the observed, partially collapsed spectrum at 2.8 atm and 295 K.

42 ENGINEERING

REFER ALSO TO CITATION(S) 22295

22739 **(INIS-SU—75) Construction and building. Scientific-technical collection.** (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1987. 76p. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780081/JAW.

Individual papers are indexed separately.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 21700, 21709, 21748, 21752, 21753, 21759, 21795, 21828, 21849, 21874, 21966, 21967, 21968, 21969, 21991, 22011, 22087, 22159, 22254, 22255, 22392, 22479, 22545, 22602, 22839, 23029, 23039, 23050, 23246, 23247, 23837, 23875

22740 **(AEEW-M—2527) Large transport packages for decommissioning waste. Semi-annual report for period 1 January - 30 June 1988.** Price, M.S.T. (ed.). (UKAEA Atomic Energy Establishment, Winfrith (UK). Materials Technology Div.). Aug 1988. 47p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705946/JAW.

This document reports progress on a study of large transport packages for decommissioning waste and is the semi-annual report for the period 1 January - 30 June 1988. The main tasks performed during the period related to the assembly of package design criteria ie those aspects of manufacture, handling, storage, transport and disposal which impose constraints on design. This work was synthesised into a design specification for packages which formed the conclusion of that task and was the entry into the final task - the development of package design concepts. The design specifications, which concentrated on the Industrial Package category of the IAEA Transport Regulations, has been interpreted for the two main concepts (a) a self-shielded package disposed of in its entirety and (b) a package with returnable shielding. Preliminary information has been prepared on the cost of providing the package as well as transport to a repository and disposal. There is considerable uncertainty about the cost of disposal and variations of over a factor of 10 are possible. Under these circumstances there is merit in choosing a design concept which is relatively insensitive to disposal cost variations. The initial results indicate that on these grounds the package with returnable shielding is preferred.

22741 **(AEEW-R—2241) Radiological evaluation of the 150mm diameter UKAEA purged posting port under conditions of high alpha activity: Pt. 1. Pressurised purge.** Smith, D.I.; Hollick, R.C. (UKAEA Atomic Energy Establishment, Winfrith (UK). Materials Technology Div.). Jul 1987. 23p. (AMPT/P—69). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705951/JAW.

The UKAEA purged posting port is an engineered transfer system for use on boxes containing high alpha activity. It is of the type that utilises a purge of gas to sweep the seals of the unit which minimises the deposition of particles during active posting operations. A 150 mm diameter port has been evaluated under highly alpha active conditions in the Fuels Laboratory, AEEW. This report details the results when tested with the purge gas (air) supplied from a pressurised source and at two nominal linear velocities (0.5 and 0.25 m sec/sup -1/) in the purged gap. The port container supplied for these tests gave purged gaps of 0.93mm and over 800 simulated posting movements were carried out. Under these conditions there was an 8 order of magnitude reduction in aerosol concentration from the active glovebox to the monitoring enclosure. The levels of loose contamination on the "clean" side of the port were within the limits set for a controlled area. The unit proved to be reliable and easy to operate and would, with a routine monitoring procedure, provide a viable alternative to existing bag posting methods.

22742 **(AEEW-R—2243) Radiological evaluation of a prototype posting-in hatch under conditions of high alpha activity.** Smith, D.I.; Hollick, R.C. (UKAEA Atomic Energy Establishment, Winfrith (UK). Materials Technology Div.). Jul 1987. 23p. (PCMRP—87-P5; DOE-RW—88.041). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705952/JAW.

A prototype posting-in hatch, mounted vertically in the top panel of a highly active glovebox has been radiologically evaluated in the Fuels Laboratory, AEEW. This simple, air-lock type system of 100 mm diameter has pneumatically operated and interlocked lids and a low velocity, inward purge, supplied by the glovebox depression. The hatch proved extremely reliable and very easy to operate. More than 1200 simulated posting movements were carried out and a > 8 order of magnitude reduction in aerosol concentra-

tion was recorded from the active glovebox to the monitoring environment.

22743 **(CEA-DAS—552) Safety approach in radioactive material transport.** Ringot, C.; Mathieu, F. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1988. 15p. (In French). (CONF-8811189—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757344/JAW.

From Pollutec-ISF exhibition; Lyon, France (22 Nov 1988).

Transport regulations are recalled. The safety is based on the packaging. Type and testing of packaging, risks, traffic of radioactive materials and intervention in case of accident are reviewed.

22744 **(CEA-DAS—553) Thermal behaviour of the type 30 B cylinder equipped with the 21 PF.1 overpack and study of protective covers for the 48 Y cylinder valve.** Warniez, P.; Ringot, C.; Perrot, J.; Bernard, H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete; CEA Centre d'Etudes Scientifiques et Techniques d'Aquitaine, 33 - Le Barp (France); Compagnie Generale des Matieres Nucleaires (COGEMA), 78 - Velizy Villacoublay (France)). (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Dec 1988. 7p. (CONF-880558—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757345/JAW.

From Uranium hexafluoride--safe handling, processing, and transporting conference; Oak Ridge, TN, USA (24 May 1988).

This paper describes the tests which have been performed in France: first to verify the behaviour of 30B cylinders with their 21 PF.1 protective overpack, secondly to develop a better mechanical protection of the valve. The thermal tests have been performed on real packagings filled with UF/sub 6/, after the mechanical AIEA tests (free drop 9 m and 1 m on a pitch). The results were very satisfactory, the maximal temperatures which were measured on the external overpack of the 30B cylinder being much lower than the filling temperature. In the Mont Louis wreckage, some of the valves of 48Y cylinders were damaged. A new valve protector was designed and was tested under impact situations. The tests have demonstrated that the new design which has the same weight as the original one and which may be used without any modifications of the cylinder, has a better behaviour, increasing the safety during transport.

22745 **(CEA-DAS—555) Thermal tests on UF6 containers and valves modelisation and extrapolation on real fire situations.** Duret, B.; Warniez, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Dec 1988. 7p. (CONF-880558—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757347/JAW.

From Uranium hexafluoride--safe handling, processing, and transporting conference; Oak Ridge, TN, USA (24 May 1988).

From realistic tests on containers or on valves, we propose a modelisation which we apply to 3 particular problems: resistance of a 48 Y containers, during a fire situation. Influence of the presence of a valve. Evaluation of a leakage through a breach, mechanically created before a fire.

22746 **(CONF-8904111—1) Dynamic modeling used for the addition of robotic operation to the Advanced Servomanipulator teleoperator.** Corbett, G.K.; Bailey, J.M. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 6p. NTIS, PC A02 - OSTI. Order Number DE89006422/JAW.

From Southeastcon '89 conference and exhibition; Columbia, SC, USA (9 Apr 1989).

A robotic mode has been added to the Advanced Servomanipulator (ASM), a 6 degree-of-freedom master/slave teleoperator. In order to understand the requirements for implementation of robotics on an arm designed for teleoperation, a dynamic simulation of the ASM slave arm was developed. The ASM model and modifications of the control system for robotic operation are presented. 7 refs., 3 figs.

22747 **(CONF-8904111—2) Comparative study of classical and robust control techniques for process control.** Murphy, G.V.; Bailey, J.M. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006031/JAW.

From Southeastcon '89 conference and exhibition; Columbia, SC, USA (9 Apr 1989).

This paper uses three different linear control system design methods to obtain three level-control systems for a simple process called a deaerator. The three linear control system design methods are proportional plus integral (PI), linear quadratic Gaussian (LQG), and linear quadratic Gaussian with loop transfer recovery (LQG/LTR). Control system performance and stability robustness are evaluated for a given set of system design specifications. The tools for analysis are the return ratio, return difference, and inverse return difference singular value plots, for a loop break at the plant output. 7 refs., 9 figs., 2 tabs.

22748 **(DOE/CE/15254—T5) [THERM-A-VALVE insulated valve coverings]: Final technical progress report.** Ball, R.D.; Smith, M.D. (Ball (Randell D.), DeQuincy, LA (USA)). 1987. Contract FG01-86CE15254. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007148/JAW.

THERM-A-VALVE is an insulation product designed to solve a major energy problem in the oil and gas exploration industry. Due to a variety of temperature, humidity, and pressure drop situations associated with the production of oil and gas, "shutdowns" occur halting production. The THERM-A-VALVE units were created to eliminate this "shut-down." THERM-A-VALVES are insulated valve coverings made of high density polyethylene which utilizes space-age quality insulation rendering the insulation protection with the highest R-Value attainable per inch of covering.

22749 **(DP-MS—88-78) Corrosion control design considerations for a new well water line.** Garrity, K.C.; Jenkins, C.F.; Corbett, R.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1989. Contract AC09-76SR00001. 15p. (CONF-890437—8). NTIS, PC A03 - OSTI. Order Number DE89006989/JAW.

From Corrosion '89; New Orleans, LA, USA (17 Apr 1989).

An impressed current cathodic protection (ICCP) system was recently installed to provide corrosion control protection for approximately 2 miles (3.2 kilometers) of underground, direct buried ductile iron piping at the Savannah River Plant (SRP). The piping system serves well water pumps and delivers the water from two newly installed water wells to the main plant area for potable and domestic water use. The route of the piping traverses a variety of soil conditions and for a significant length, is installed in a power line right-of-way with direct buried copper cable counterpoise. The conditions presented a unique challenge for the designers of the corrosion control system, especially considering the safety precautions required. Extensive detailed testing was performed along the proposed route of the pipeline. This was required to gather the engineering data necessary to establish soil characteristics and the specific requirements for such a corrosion control system. The results of the testing, the design options which were evaluated, the problems encountered during construction, and the effectiveness of the installed system are discussed. 3 refs., 10 figs., 2 tabs.

22750 **(GA-A—19417) GA-4 and GA-9 legal weight truck shipping cask development.** Grenier, R.M.; Meyer, R.J.; Jensen, M.F. (General Atomics, San Diego, CA (USA)). Feb 1989. Contract AC07-88ID12698. 12p. (CONF-890207—13). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007645/JAW.

From Waste management '89; Tucson, AZ, USA (26 Feb 1989).

We are developing two new legal weight truck spent fuel shipping casks that will carry four PWR or nine BWR spent fuel assemblies. They are being developed to meet requirements to dispose of nuclear wastes at a permanent disposal site. Our primary goal is to maximize the number of fuel elements of each fuel type

that a legal weight truck (LWT) cask can carry, while ensuring that the design meets all NRC licensing requirements. 1 ref., 4 figs.

22751 (IEIE—8801, pp 45-48) **Present development and future outlook of high temperature oxide superconducting materials. Use of superconductive oxide as material.** Hagiwara, Hiroyasu. (Toshiba Research and Development Center, Kawasaki, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

Superconductivity application technology has been developed based on the metal superconducting material and various new products have been invented in many fields. However, application to electronics is still developing. This paper examines the application of superconducting oxides to electronics and considers its future trend. The current condition of metal superconductor as superconducting material is analyzed in electronics field which is necessary for development of superconductive oxide. Various methods for practical use of superconductive oxide are also reported. The results revealed that research and development of superconductive oxides in electronics is still in the early stage and that study of physical properties and correct recognition as substances are necessary.

22752 (IEIE—8801, pp 49-52) **Application of high temperature superconductive oxides to rotors.** Maki, Naoki. (Hitachi, Ltd., Tokyo, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

Superconducting rotors with superconducting field winding has advantages such as miniaturization, weight reduction, improvement of efficiency, and improvement of line stability. Therefore, application of recently discovered high temperature superconducting oxides (high Tc material) to rotors is considered. This paper describes the effect of applying high temperature superconducting oxides to rotors. Rotors handled in this study are those which are used in the following machines: turbine-driven synchronous generators for thermal or atomic power generation, radiofrequency generators for aircraft or spacecraft, single-pole pulse generators, car motors, motors for electric car or ships, industrial motors, linear motors, and solenoid actuated craft. The effect of application to large equipment is also discussed; basic design specification is defined, cost of conventional generator is compared to that of superconducting generator, and advantage of superconducting generator is revealed. Further technological subject in this field for the future is also suggested. (3 figs, 4 tabs, 1 ref)

22753 (IEIE—8801, pp 81-84) **Gigantic artificial lightning generators and their application.** Harada, Tatsuya; Murooka, Yoshihiro. (Saga Univ., Saga, Japan; The National Defence Academy, Yokosuka (Japan)). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

This paper is a summary of papers devoted to the theme of gigantic artificial lightning generators and their application. It outlines artificial lightning generators, which were previously called shock voltage generators and currently called impulse voltage generators, at present in Japan with some comments on trends outside Japan. The subjects or viewpoints covered are as follows: (1) History of artificial lightning generators, (2) artificial lightning generators at present, (3) problems which are expected to be solved using gigantic artificial lightning generators, and (4) problems concerning site selection and installation. (6 figs, 1 tab, 7 refs)

22754 (IEIE—8801, pp 85-87) **Gigantic artificial lightning generators and results of survey on their applications.** Hasuo, Norihiro. (Kyushu Electric Power Co. Ltd., Fukuoka, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

Gigantic artificial lightning generators are needed to simulate natural lightning. A questionnaire concerning the application of such apparatuses was issued to 37 organizations concerned during the period from September to October, 1987. According to the results of the questionnaire, this paper summarizes needs for gigantic artificial lightning generators from a qualitative viewpoint and the required size of such apparatuses. The subjects covered are as follows: (1) Outline of the questionnaire, (2) use (or necessity) of gigantic artificial lightning generators, (3) voltage, current, and energy required for gigantic artificial lightning generators, and (4) reasoning for voltage, current, and energy requirements. (1 fig, 2 tabs)

22755 (IEIE—8801, pp 89-92) **Gigantic Marx artificial lightning generator.** Den, Minoru; Hiyama, Tatsuya; Mori, Hitoshi; Tokuchi, Akira. (Nichikon Capacitor Ltd., Kyoto,, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

This paper outlines the test design of the gigantic Marx artificial lightning generator (hereafter abbreviated as GMG) which was conducted by Nichicon Corp. according to an order from the Electric Power Research Institute of Kyushu Electric Power Co., Inc., focusing on the new design scheme. Two types of generator were designed: one with a rated voltage of 30 MV and the other with 50 MV, both with a charging energy of 30 MJ. The paper mainly discusses the 30-MJ type which can be fabricated more easily. The subjects covered are as follows: (1) Rating of the equipment, (2) the appearance and structure of the equipment, (3) the main discharging circuit in the GMG, (4) features of each section in the GMG, (5) the upper limit of the on/off impulse voltages, (6) the strength of the insulated base, (7) the period needed for fabricating the GMG, and (8) results of simulation of output voltage, current, and other parameters of the GMG. (11 figs, 1 tab)

22756 (IEIE—8801, pp 93-96) **Gigantic balloon type artificial lightning generator.** Horii; kenji. (Nagoya Univ., Nagoya, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

This paper outlines a hot-air balloon type Van de Graaf 50-MV generator which can generate a 50,000,000 V, 0.2 to 0.3 coulomb artificial lightning comparable to natural lightning discharge and reports the results of investigation on discharging experiments conducted using this apparatus. The subjects covered are as follows: (1) Outline of the hot-air balloon type Van de Graaf 50-MV generator, (2) electric characteristics of the Van de Graaf 50-MV generator, (3) charge transfer with film and balloon charging, (4) the load of the balloon and buoyancy calculation, (5) leakage of charges, (6) study of charging experiments, and (7) evaluation of the apparatus and its method and problems to be solved. (4 figs, 4 tabs, 4 refs)

22757 (IEIE—8801, pp 97-99) **Application to study on big gap discharging.** Akasaki, Masanori. (Kyushu Univ., Fukuoka, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

This paper discusses the application of gigantic artificial lightning generators to study on big gap discharging. The subjects covered are as follows: (1) Discharging in atmosphere and discharging conducted in experiment are compared, and the difference between the two is discussed. (2) The studies conducted thus far are reviewed, and the requirements for producing big gap discharging are discussed. (3) Problems concerning measurement and control of big gap discharging are discussed with consideration on the newly developed technology in this field. (4) Some comments are made on the technical report "Characteristics of and Theoretical

Progress on Long Gap Discharging " issued by that Study Group in the Society of Electrical Engineers which is studying the space charge effect in long gap discharging. (4 figs, 8 refs)

22758 (IEIE—8801, pp 101-104) **Application to study on lightning shielding.** Inoue, Nobuyuki; Aihara, Yoshinori; Kawamura, Tatsuo. (Central Research Inst. of Electric Power Industry, Tokyo, Japan; The Univ. of Tokyo, Tokyo(Japan)). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

This paper discusses the application of gigantic artificial lightning generators to study on the cause of failure to provide a shield from lightning in winter. The subjects covered are as follows: (1) Experimental and theoretical studies on shielding from lightning are reviewed. (2) Experiments conducted for shielding from lightning in winter using gigantic artificial lightning generators are reviewed, focusing on experiment methods, conditions, models, and scopes. (3) Limitations and positioning of experiments are discussed. (3 figs, 2 tabs, 15 refs)

22759 (IEIE—8801, pp 105-108) **Application to study on phenomena involving very high voltage and large current impulse.** Suzuki, Toshio. (Central Research Inst. of Electric Power Industry, Tokyo, Japan). 5 Sep 1988. (In Japanese). NTIS (US Sales Only), PC A09. Order Number DE88757165/JAW. (CONF-8810337—Pt.1).

From Joint convention record of institutes of electrical and information engineers; Niigata, Japan (3 Oct 1988).

This paper discusses to what studies gigantic artificial lightning generators can be applied, focusing on problems concerning power transmission technology and its present level. Subjects covered are as follows: (1) Application to lightning study -- application to lightning-proof design of power transmission and distribution lines and substations and application for preventing lightning accidents are discussed. (2) Application to in-air insulation design. (3) Other application examples -- the use of lasers for guiding lightning, lightning to aircraft and rockets, and electromagnetic interference on electronic equipment and LSI are discussed. (4) Finally, the basic performance of gigantic artificial lightning generators is summarized. (3 figs, 3 tabs, 7 refs)

22760 (INIS-BR—1440, pp 42) **Adjustment system and vacuum remote control for hot cells.** Almeida, G.L. de; Silva, A.C.C. da. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22761 (INIS-BR—1440, pp 43) **Apparatus of a remote sterilization cell for radioisotopes.** Almeida, G.L. de; Serra, M.L.S.; Souza, A.S.F. de; Pereira, C.C.R. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22762 (INIS-BR—1440, pp 45) **Apparatus of a hot cell for /sup 67/Ga processing.** Almeida, G.L. de; Souza, A.S.F. de; Pureza, M.M.; Serra, M.L.S. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22763 (INIS-BR—1440, pp 47) **Sampling system and remote handling of waste for radiosotope processing cells.** Almeida, G.L. de; Souza, A.S.F. de. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

published in summary form only.

22764 (INIS-SU—75, pp 25-29) **Gating devices for radiation-protection chambers with top loading.** Lukishov, G.I.; Kimaev, M.A. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780081/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Construction and building. Scientific-technical collection.

Several variants of protective gates with remote control, applied in protection chambers with top loading and discharge of radioactive materials are presented. Application of such gates provides for a reliable loading with simultaneous biological protection provisions. 3 figs.

22765 **(JAERI-M—88-235) CASKETSS-HEAT: a finite difference computer program for nonlinear heat conduction problems.** Ikushima, Takeshi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Dec 1988. 139p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88757268/JAW.

A heat conduction program CASKETSS-HEAT has been developed. CASKETSS-HEAT is a finite difference computer program used for the solution of multi-dimensional nonlinear heat conduction problems. Main features of CASKETSS-HEAT are as follows. (1) One, two and three-dimensional geometries for heat conduction calculation are available. (2) Convection and radiation heat transfer of boundry can be specified. (3) Phase change and chemical change can be treated. (4) Finned surface heat transfer can be treated easily. (5) Data memory allocation in the program is variable according to problem size. (6) The program is a compatible heat transfer analysis program to the stress analysis program SAP4 and SAP5. (7) Pre- and post-processing for input data generation and graphic representation of calculation results are available. In the paper, brief illustration of calculation method, input data and sample calculation are presented.

22766 **(JAERI-M—88-236) Computational method of the inverse kinematics via simplified algebraic equation.** Sasaki, Shinobu. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Dec 1988. 19p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757269/JAW.

A transformation into an algebraic equation, proposed as a method of solving the inverse kinematics for a six-link manipulator, left a room for further improvement of the method due to invalid solutions arising from the properties of a high order polynomial. Following its initial concept, joint solutions have been determined by solving the 16th order polynomial derived from the original equation. This order, however, is still high enough from a viewpoint of practical use. On close examination returning to the original equation, an alternative idea occurred which is based on factorization method in order to find out common factors. As a result, the kinematic relationships in question could be re-expressed in terms of a simple algebraic equation of the 8th order. This paper is concerned with detailed derivation process.

22767 **(JAERI-M—88-239) POST-CASKETSS: a graphic computer program for thermal and structural analysis of nuclear fuel shipping casks.** Ikushima, Takeshi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Dec 1988. 86p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757270/JAW.

A computer program POST-CASKETSS has been developed for the purpose of calculation result representation for thermal and structural analysis computer code system CASKETSS (CASKETSS means a modular code system for CASK Evaluation code system for Thermal and Structural Safety). Main features of POST-CASKETSS are as follows; (1) Function of calculation result representation for thermal and structural analysis computer programs is provided in the program. (2) Two and three dimension-

al graphic representation for finite element and finite difference programs are available in the program. (3) The capacity of graphics of geometry, temperature contor and temperature-time curve are provided for thermal analysis. (4) The capacity of graphics of geometry, deformation, stress contor, displacement-time curve, velocity-time curve, acceleration-time curve, stress-time curve, force-time curve and moment-time curve are provided for structural analysis. (5) This computer program operates both the time shearing system and the batch system. In the paper, brief illustration of calculation method, input data and sample calculations are presented.

22768 **(JAERI-M—88-240) PRE-CASKETSS: an input data generation computer program for thermal and structural analysis of nuclear fuel shipping casks.** Ikushima, Takeshi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Dec 1988. 60p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88757271/JAW.

A computer program PRE-CASKETSS has been developed for the purpose of input data generation for thermal and structural analysis computer code system CASKETSS (CASKETSS means a modular code system for CASK Evaluation code system for Thermal and Structural Safety). Main features of PRE-CASKETSS are as follow; (1) Function of input data generation for thermal and structural analysis computer programs is provided in the program. (2) Two- and three-dimensional mesh generation for finite element and finite difference programs are available in the program. (3) The capacity of the material input data generation are provided in the program. (4) The boundary conditions, the load conditions and the initial conditions are capable in the program. (5) This computer program operate both the time shearing system and the batch system. In the paper, brief illustration of calculation method, input data and sample calculations are presented.

22769 **(JAERI-M—88-243) Representations of a linkage mechanism based on dual number matrices.** Sasaki, Shinobu. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Dec 1988. 19p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757273/JAW.

In this paper, the kinematics problem of robot manipulators is discussed from a viewpoint of developing a new analytical technique using a concept based on a dual number algebra. Concerning its formulation, 3 x 3 orthogonal matrices of dual number elements with a complete description of link geometry are first introduced and simple multiplication operations are sequentially performed to obtain kinematic equations. In the application process to a six-link manipulator, an expedient idea was especially effective to lighten the burden of formulation complexity involved in the last computational step. The major advantage of the present method is the capability to determine at the same time both spacial position and orientation of manipulator hand irrespective of 3 x 3 matrix operations.

22770 **(LA-UR—89-266) Optimization for object localization of the constrained algebraic reconstruction technique.** Hanson, K.M. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 9p. (CONF-890115—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007755/JAW.

From 3. conference on medical imaging; Newport Beach, CA, USA (29 Jan 1989).

A method for optimizing image-recovery algorithms is presented that is based on how well the specified task of object localization can be performed using the reconstructed images. The task performance is numerically assessed by a Monte Carlo simulation of the complete imaging process including the generation of scenes appropriate to the desired application, subsequent data taking, image recovery, and performance of the stated task based on the final image. This method is used to optimize the constrained Algebraic Reconstruction Technique (ART), which reconstructs images from their projections under a nonnegativity constraint by means of an iterative updating procedure. The optimization is performed by finding the relaxation factor, which is employed in the updating procedure, that yields the minimum rms error in estimating the position of discs in the reconstructed images. It is found that the optimum operating points for the best object localization are essentially the same as those obtained earlier when the performance of simple object detection is to be optimized. 11 refs., 3 figs., 2 tabs.

22771 **(LA-UR—89-300) Direct laser/materials interaction: Laser ablation of superconductor materials and laser welding.** Cremers, D.A.; Dixon, R.D.; Estler, R.C.; Lewis, G.K.; Lyman, J.L.; Muenchausen, R.E.; Nogar, N.S.; Pitch, M. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 28p. (CONF-890435—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006560/JAW.

From 6. international conference on high temperatures: chemistry of inorganic materials; Gaithersburg, MD, USA (3 Apr 1989).

This paper considers two applications of direct laser/materials interaction, laser ablation of superconductor materials and Nd-YAG laser welding. The laser ablation experiments with 355 nm, 10 ns pulses have demonstrated uniform, thin superconductor films. The film uniformity was improved significantly be rotating both the laser target and the film support, and by vertically dithering the laser focus. The film stoichiometry does vary with laser fluence, but it is within 10% of the target material at high fluence. Annealing of the thallium-containing films restores lost oxygen. For the welding application we have investigated the conditions that influence the melt depth. High speed photography has shown the plume to consist of a series of regenerated pulses that move in a direction normal to the surface. The time for plume initiation and the laser power threshold for plume formation are dependent on the substrate material. The plume temperatures depended on the welding atmosphere. Temperatures and melt depths are higher for the reactive gases, air, O_2, and SF_6, than for the nonreactive gases, He, Ar, and N_2. 18 refs., 13 figs.

22772 **(LBL—25877) The concept of causality in image reconstruction.** Llacer, J.; Veklerov, E.; Nunez, J. (Lawrence Berkeley Lab., CA (USA)). Sep 1988. Contract AC03-76SF00098. 18p. (CONF-8809313—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008170/JAW.

From NATO Advanced Study Institute; Povoa, Portugal (12 Sep 1988).

Causal images in emission tomography are defined as those which could have generated the data by the statistical process that governs the physics of the measurement. The concept of causality was previously applied to deciding when to stop the MLE iterative procedure in PET. The present paper further explores the concept, indicates the difficulty of carrying out a correct hypothesis testing for causality, discusses the assumption needed to justify the tests proposed and discusses a possible methodology for a justification of that assumption. The paper also describes several methods that we have found to generate causal images and it shows that the set of causal images is rather large. This set includes images judged to be superior to the best maximum likelihood images, but it also includes unacceptable and noisy images. The paper concludes by proposing to use causality as a constraint in optimization problems. 16 refs., 5 figs.

22773 (RISO-M—2756, pp 112-179) **Manufacturing and application of superconducting wires.** Laverick, C.; Hulm, J.K. Dec 1988. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88757390/JAW. (CONF-8806233—).

From Topsoe summer school on superconductivity; Risoe, Denmark (20 Jun 1988).

In this paper, some of the characteristics of the new materials bearing on their utilization are examined and some of the principal barriers to application are assessed. Some of the promises and successes in applying superconductors over the past 28 years are discussed and the implications of the new discoveries from the point of view of application considered.

22774 (RISO-M—2756, pp 180-241) **Squid concepts and systems.** Clarke, J. (California Univ., Berkeley (USA). Dept. of Physics; Lawrence Berkeley Lab., CA (USA). Materials and Chemical Sciences Div.). Dec 1988. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88757390/JAW. (CONF-8806233—).

From Topsoe summer school on superconductivity; Risoe, Denmark (20 Jun 1988).

In this chapter I try to give an overview of the current state of the SQUID art. I cannot hope to describe all of the SQUIDs that have been made or, even less, all of the applications in which they have been successfully used. I begin, in Sec. II, with a brief review of the resistively-shunted Josephson junction, with particular emphasis on the effects of noise. Section III contains a description of the dc SQUID: how these devices are made and operated, and the limitations imposed by noise. Section IV contains a similar description of the properties of rf SQUIDs, but because there has been little development of these devices in the 1980's, I shall keep this section relatively brief. In Sec. V, I describe a selection of instruments based on SQUIDs and mention some of their applications. Section VI contains a discussion of the impact of high temperature superconductivity on SQUIDs, and of future prospects in this area, while Sec. VII contains a few concluding remarks.

22775 (SAND—88-0442C) **An approximate method for calculating aircraft downwash on parachute trajectories.** Strickland, J.H. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 15p. (AIAA—89-0899; CONF-8904118—9). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008122/JAW.

From 10. AIAA aerodynamic decelerator systems technical conference; Cocoa Beach, FL, USA (18 Apr 1989).

An approximate method for calculating velocities induced by aircraft on parachute trajectories is presented herein. A simple system of quadrilateral vortex panels is used to model the aircraft wing and its wake. The purpose of this work is to provide a simple analytical tool which can be used to approximate the effect of aircraft-induced velocities on parachute performance. Performance issues such as turnover and wake recontact may be strongly influenced by velocities induced by the wake of the delivering aircraft, especially if the aircraft is maneuvering at the time of parachute deployment. 7 refs., 9 figs.

22776 (SAND—88-2366C) **Nonlinear finite element simulation of the large angle motion of flexible bodies.** Peterson, L.D. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 32p. (CONF-8904112—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006505/JAW.

From 30. structures, structural dynamics and materials conference; Mobile, AL, USA (3 Apr 1989).

Finite element simulations of the geometrically nonlinear, large angle motion of flexible bodies are presented and discussed. The simulations use ABAQUS, a commercially available nonlinear, large strain-displacement structural finite element program. To evaluate the capabilities of ABAQUS, simulation results for three examples are presented: a large angle maneuver of a cantilevered beam, the nutation of a rotating free-free beam observed from a rotating frame, and the spin-up of a cantilevered beam from rest. The spin-up problem is a standard test case which tests for false divergence of the beam above a critical spin rate. In these simple examples, ABAQUS successfully simulates the large rotational motion, correctly capturing the geometrically nonlinear effects. The success of these simple examples indicates that ABAQUS, or similar nonlinear finite element programs, could be used to simulate the large angle rotation of arbitrary structures when a high fidelity truth model is desired. 9 refs., 15 figs., 3 tabs.

22777 (SAND—88-2377C) **An experimental and analytical synthesis of controlled structure design.** Peterson, L.D.; Allen, J.J.; Lauffer, J.P.; Miller, A.K. (Sandia National Labs., Albuquerque, NM (USA)). [1989]. Contract AC04-76DP00789. 32p. (CONF-8904112—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006506/JAW.

From 30. structures, structural dynamics and materials conference; Mobile, AL, USA (3 Apr 1989).

An overview of the experimental and analytical results from a controlled structure technology development project are reported and discussed. A controller was designed to reject disturbances from a lightly damped truss structure, in which twenty structural modes lie within the controller bandwidth. The signals from four strain sensors are fed back through an eighteenth order dynamic controller into four stress actuators (not collocated with the sensors) to reduce the vibration of the structure. Five independent performance measures are simultaneously minimized to synthesize the controller. An optimal projection controller, designed from a 58th order state space model, experimentally reduces the structural vibration by up to 65% without saturating the actuators and without destabilizing high frequency modes. By comparing analytical and experimental performance predictions, the robustness of the controller to model imperfections is demonstrated. The overall procedure reported here demonstrates a complete analysis, control synthesis, and test of a realistic controlled structure. 27 refs., 6 figs., 5 tabs.

22778 (SAND—88-2456C) **Wall-interference corrections for parachutes in a closed wind tunnel.** Macha, J.M.; Buffington, R.J. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 22p. (CONF-8904118—10). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007430/JAW.

From 10. AIAA aerodynamic decelerator systems technical conference; Cocoa Beach, FL, USA (18 Apr 1989).

An extensive test program was conducted to gather information on wall-interference effects for parachutes in closed wind tunnels. Drag area and base pressure measurements were made for a set of ribbon parachutes of 7%, 15% and 30% geometric porosity in six different wind tunnels, covering a range of geometric blockages from two to thirty-five percent. The resulting data have been used to formulate and validate approximate blockage correction equations based on the theory of Maskell. The corrections are applicable to single parachutes and clusters of two and three parachutes. 8 refs., 7 figs., 1 tab.

22779 (SAND—88-2468C) **Small parachute flight data acquisition system.** Ryerson, D.E.; Hauser, G.C. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 5p. (CONF-8904118—7). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008114/JAW.

From 10. AIAA aerodynamic decelerator systems technical conference; Cocoa Beach, FL, USA (18 Apr 1989).

Sandia National Laboratories does extensive parachute design and testing. In support of that work, Sandia's Telemetry Department has designed and fielded a small, inexpensive data acquisition system. The system has been used in over fifty parachute and water entry tests. It consists of a microprocessor controlled unit which digitizes up to eight channels of signal-conditioned analog data and stores the data in memory for readout after the test. The system is also capable of doing control functions such as releasing the parachute at a predetermined time after unit release. 4 refs., 7 figs.

22780 (SAND—88-2551) **Prediction and measurement of damping of a laminated beam with a constrained viscoelastic layer.** Segalman, D.J.; Reamy, P. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1989. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009002/JAW.

Analytic predictions for damped natural frequencies of a simple viscoelastic structure are compared with measured values. The structure studied is an aluminum channel incorporating a constrained layer of highly viscoelastic polymer. The predictive technique employs a general and systematic method for calculating damping and stiffness matrices using only measured material properties and structure geometry. These matrices are then used to predict the dynamic properties of the structure. This work constitutes the first step in the experimental verification of the analytic method. Future work will demonstrate and test some of the unique capabilities of the analytic method including the ability to predict even the complex modes of viscoelastic structures. The experimental and analytic results are in the form of frequency response func-

tions, and the frequencies and damping of the natural modes. The natural frequencies agreed to within 5%, as expected, and the damping values agreed to within the uncertainty in the properties of the viscoelastic damping material. The measured and predicted mode shapes, as compared using the Modal Assurance Criterion (MAC), also agreed closely. Agreement between the predicted and measured response of the structure studied is very good, and indicating that the analytic technique used is a viable method for modeling viscoelastically damped structures. 10 refs., 6 figs., 6 tabs.

22781 **(SAND—88-2592C) Development of an alternating flat to tubular Kevlar parachute tape.** Ericksen, R.H.; Koch, R. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 10p. (CONF-8904118—5). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007426/JAW.

From 10. AIAA aerodynamic decelerator systems technical conference; Cocoa Beach, FL, USA (18 Apr 1989).

An alternating flat to tubular Kevlar tape was developed to replace braided suspension lines and woven tape radials on the new crew escape module parachute system for the F-111 aircraft. Weaves were developed which had high strength efficiency and low weight throughout the flat, tubular, and transition sections. A tubular section strength of 535 lbs at a weight of 0.044 oz/yd was achieved. This reduces suspension line weight by 8% compared with that of the most efficient braid which has a strength of 470 lbs and weighs 0.048 oz/yd. Length measuring procedures for production control and inspection were developed. Using these procedures it was possible to produce alternating weave fabric with less than 1% variation in length in the tubular sections. 3 refs., 4 figs., 3 tabs.

22782 **(SAND—88-2750C) Measurements of individual parachute loads in a clustered parachute system.** Behr, V.L. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 5p. (CONF-8904118—8). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007656/JAW.

From 10. AIAA aerodynamic decelerator systems technical conference; Cocoa Beach, FL, USA (18 Apr 1989).

When developing any parachute system, it is necessary to know the loads produced by the parachute throughout the deployment process. A major concern with a clustered parachute system is the nonconcurrent inflation of the individual parachutes. If this nonconcurrent inflation produces sufficiently large asymmetric loads, the design loads may be exceeded. In the past, load data have frequently been inferred from acceleration data of the parachute test vehicle. However, due to vehicle angle of attack and attitude relative to the longitudinal axis of the parachute, this method can give erroneous results. Thus, in the development of parachute systems, it is desirable to have an instrumentation system which can directly measure the load produced by each parachute. Due to the environment, this system must be very rugged and have minimal space requirements. Such a system has been designed and incorporated into a test program at Sandia National Laboratories. The system is described and representative test results are given to demonstrate the usefulness of such a system in a development program. 3 refs., 6 figs.

22783 **(SAND—88-2751C) The development and testing of the HISAC parachute recovery system.** Behr, V.L. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 6p. (CONF-8904118—6). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007585/JAW.

From 10. AIAA aerodynamic decelerator systems technical conference; Cocoa Beach, FL, USA (18 Apr 1989).

The High Speed Airdrop Container (HISAC) is currently being developed by Sandia National Laboratories for the US Army. The 825 lb HISAC will be delivered from altitudes as low as 200 ft above ground level and speeds as high as Mach 0.95. The parachute recovery system must produce an impact velocity less than 40 fps, an impact angle greater than 70 deg from horizontal and a maximum deceleration less than 30 g's. Candidates for main parachutes to be used in the recovery systems have included a cluster of three 21-ft-dia ribbon parachutes, a cluster of two 22-ft-dia ringslot cargo parachutes, a single high strength 35-ft-dia T-10 canopy, and a cluster of three standard 35-ft-dia T-10 parachutes. Results from airdrop and ground tests indicate that the use of a reefed and staged drogue in conjunction with a cluster of three standard unreefed T-10 personnel parachutes provides the best combined turnover and impact velocity characteristics. Initial deployment of the drogue parachute is produced by an aerodynamically deployed tailplate which produces no appreciable carriage drag. Results from ground tests indicate that reliable deployment of the tailplate is achievable through the use of aerodynamic drag surfaces which are deployed shortly after the HISAC is released from the carriage aircraft. 5 refs., 3 tabs.

22784 **(SAND—88-2960C) A computer controlled 100 kV pulse generator.** Kupferman, S.L.; Booker, S.R.; Meissner, H.J. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 7p. (CONF-8904116—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005922/JAW.

From IMTC conference; Washington, DC, USA (25 Apr 1989).

A high voltage pulse generator used primarily for calibrating precision high voltage dividers has been redesigned and rebuilt for state of the art operation. It now has the capability to run a divider calibration, compare the results with historical data for the divider, and then print a calibration certificate, all under computer control. Thirteen component instruments are controlled via three IEEE 488 buses. A voice synthesizer is used to inform the operator of the progress of the calibration. Measurement precision is in the 0.1 % range. A heat exchanger is used to control the temperature of the oil bath to allow calibration of dividers between 13{degree}C (55{degree}F) and 21{degree}C (70{degree}F). Positive or negative pulse polarity may be selected and pulse magnitude is settable from less than 10 kV to greater than 300 kV. 1 ref., 8 figs., 1 tab.

22785 **(SAND—88-3058C) A preliminary characterization of parachute wake recontact.** Strickland, J.H.; Macha, J.M. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 8p. (CONF-8904118—3). NTIS, PC A02 - OSTI. Order Number DE89006442/JAW.

From 10. AIAA aerodynamic decelerator systems technical conference; Cocoa Beach, FL, USA (18 Apr 1989).

A series of tests was conducted on a 10-ft.-diameter ringslot parachute with a geometric porosity of 20% to establish the conditions under which "wake recontact" occurs. The vertical helicopter drop tests covered a range of mass ratios from 0.5 to 3.0 and a range of Froude numbers from 70 to 400. Data consisted of velocity time histories obtained using a laser tracker and diameter time histories obtained from photometric data. A collapse parameter based on the ratio of the maximum parachute diameter to the subsequent minimum diameter was correlated with the mass ratio M/sub R/ and the Froude number Fr or equivalently with the initial to final velocity ratio V/sub o//V/sub t/. For large values of V/sub o//V/sub t/ the collapse parameter R/sub c/ appears to be a function of M/sub R/ alone. Non-dimensional opening time and "collapse time" data were also correlated with M/sub R/ and V/sub o//V/sub t/. 11 refs., 10 figs., 1 tab.

22786 **(SAND—89-0410C) Testing of a new recovery parachute system for the F111 aircraft crew escape module: An update.** Johnson, D.W. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 7p. (CONF-8904118—4). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007139/JAW.

From 10. AIAA aerodynamic decelerator systems technical conference; Cocoa Beach, FL, USA (18 Apr 1989).

A new recovery parachute system has been designed for the F111 crew escape module (CEM). The system includes a cluster of three 49-ft-dia ringslot-solid parachutes, a Kevlar deployment bag, and an explosively fired drogue gun to deploy the pilot parachute. Tests have been conducted that indicate the parachute system will meet the rate of descent requirement of 25 ft/sec at 5000 ft pressure altitude. To control the drag load developed by the parachutes, a new central reefing/disreefing system has been developed. Since the recovery parachute system is normally deployed crosswind from the CEM, line sail of the suspension lines during early tests was a problem but has been minimized by a dual pilot parachute system. 6 refs., 7 figs.

22787 **(SAND—89-0615C) Performance of the RHIC-II clean room facility at Sandia National Laboratories.** Brown, N.E.; Van Geet, O.D.; Liu, B.Y.H.; O'Hanlon, J.F. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 12p. (CONF-8811182—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008579/JAW.

From Microcontamination Mag and Exposition Management Association conference; Santa Clara, CA, USA (16 Nov 1988).

The clean rooms in the new Radiation Hardened Integrated Circuit (RHIC-II) Facility have become operational. Design philosophy and information on the air handling system, initial data on particulate contamination levels in clean bays, service chases and the make up air system will be presented. Data on power consumption, particulate levels before and after the HEPA filters and sound levels with air velocities from 95 to 57 feet per minute will be reported. 2 refs., 5 figs., 4 tabs.

22788 **(SAND—89-0809C) A calorimetric-based comparison of gas tungsten and plasma arc welding processes.** Knorovsky, G.A.; Fuerschbach, P.W. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 18p. (CONF-8810176—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008712/JAW.

From JOWOG 22D joining subgroup; Aldermasten, UK (4 Oct 1988).

Measurements of arc and melting efficiencies have been made for pulsed and continuous mode Gas Tungsten Arc Welding (GTAW) and Plasma Arc Welding (PAW) processes. Welds were made on 2.5 mm total thickness pure Ni and 304 Stainless Steel in a standing edge weld geometry at constant nominal machine output settings which varied average current with travel speed. Under continuous current conditions, the measured heat input remained approximately constant for the conditions examined (250-1250 mm/min), while melting efficiency increased dramatically (0-{approximately}0.4). Arc efficiencies were relatively constant, remaining in the range of {approximately}0.75-0.85 for GTAW and somewhat less for PAW. Values of melting efficiency for Ni were slightly less than those for 304 when compared at similar travel speeds, though both tended toward the same limit ({approximately}0.4). The PAW results were not appreciably higher than the GTAW. In addition to melting efficiency the centerline depth of penetration was also measured. In contrast to the GTAW results, which increased with speed at lower travel speeds and then plateaued at 0.8 mm, the PAW results increased monotonically with speed to a maximum of 1.0 mm. In conclusion, calorimetric measurements of nonconsumable arc welding processes have been found helpful in understanding conditions under which efficient arc welds with minimal heat inputs for a desired weld penetration can be made. 10 figs.

22789 **(UCRL—98957) Design of a new high precision computer numerical control.** Sweeney, D.J.; Weinert, G.F. (Lawrence Livermore National Lab., CA (USA)). 23 Jun 1988. Contract W-7405-ENG-48. 6p. (CONF-880887—33). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008032/JAW.

From 32. international technical symposium on optical and opto-electronic applied science and engineering; San Diego, CA, USA (14 Aug 1988).

The purpose of this project is to produce a generic high precision computer numerical controller (CNC) for use on microinch- and sub-microinch-resolution machine tools at the Lawrence Livermore National Laboratory. In order to fully utilize the potential of these machine tools, the CNC must include the ability to use multiple feedback sensors on each machine axis, incorporate corrections for quasistatic geometric errors (such as straightness, and squareness), be able to function over a relatively large range of motion (in excess of 60 inches per axis), and be able to produce motion updates at a rate sufficient to take advantage of the high bandwidth of the servo systems. At present, no commercially available CNC can presently meet all of the resolution, feed rate, and length of travel requirements of these machines. In order to minimize the complexity of the system, and thereby increase its reliability and maintainability, the programming was done in a high level language. The number of processors was kept as small as possible while still maintaining the performance requirements. We also used commercially available hardware in preference to building, in order to increase both reliability and maintainability. Special emphasis was given to making the CNC's operator interface as friendly as possible. We have completed a prototype control. We plan to install and test it in 1988. 4 figs.

22790 **(UCRL—99501) Dynamic characteristics of the LLNL Precision Engineering Research Lathe.** Franse, J.; Roblee, J.W.; Modemann, K. (Lawrence Livermore National Lab., CA (USA)). 31 Aug 1988. Contract W-7405-ENG-48. 17p. (CONF-8810335—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008829/JAW.

From 3. annual precision engineering conference of the American Society for Precision Engineering; Atlanta, GA, USA (24 Oct 1988).

The dynamic characteristics of the Precision Engineering Research Lathe (PERL) have been investigated experimentally, up to a frequency of 1000 Hz. In successive tests, the exciting force was applied to either the X slide or the (non-rotating) spindle, and in the X or Z direction. These are the critical directions for turning operations on this T base type lathe. Each of these tests was furthermore done with the servo system active and with the servo system off (slides clamped, control loops open). The applied force fluctuations and the resulting relative displacement, between a capacitive probe mounted on the X slide and the spindle, were measured during the experiments. From these data, the relative dynamic compliances between the tool and the workpiece, in the Z and X directions, have been determined. The most important resonant frequencies, modes, and compliances are reported. Their consequences with regard to the surface quality of diamond turned parts are also discussed. 3 refs., 11 figs.

22791 **(WHC-EP—0199) Fabrication procedure for electrical insulators for pulsed magnetic welding inductors.** Rolie, C.M. (Westinghouse Hanford Co., Richland, WA (USA)). Dec 1988. Contract AC06-87RL10930. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008797/JAW.

This procedure describes the materials, tools, facility, and fabrication steps required to produce an electrical insulator. 27 figs.

22792 **S parameter measurements on single superconducting thin-film three-terminal devices made of high-T/sub c/ and low-T/sub c/ materials.** Martens, J.S.; Hohenwarter, G.K.G.; Beyer, J.B.; Nordman, J.E.; Ginley, D.S. (University of Wisconsin-Madison, Department of Electrical and Computer Engineering, 1415 Johnson Drive, Madison, Wisconsin 53706-1691). *Journal of Applied Physics;* **65**: No. 10, 4057-4060(15 May 1989).

We have investigated three-terminal single-layer thin-film superconducting devices made of YBaCuO and Nb. The devices incorporate regions of weak superconductivity in multiple parallel links that are influenced by current in a separate control line. These experiments were designed to study the possible application of this device as an rf amplifier. With the device biased, rf power was applied to the control line and the transmission coefficient, S/sub 21/, was measured. The reverse transmission coefficient, S/sub 12/, was also measured for comparison. Upon biasing into a flux flow state, the S/sub 21/ of the device at rf frequencies was found to increase 10--15 dB over the zero bias value and over the reverse feed (S/sub 12/) value. The device behaved linearly up to power inputs of +5 dBm (1-dB compression point). The bandwidth was limited only by the impedance transformer.

22793 **Bias-induced nonlinearities in the dc I-V characteristics of neutron-transmutation-doped germanium at liquid-^{4}He temperatures.** Kenny, T.W.; Richards, P.L.; Park, I.S.; Haller, E.E.; Beeman, J.W. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **39**: No. 12, 8476-8482(15 Apr 1989).

Nonthermal nonlinearities in neutron-transmutation-doped germanium resistance thermometers have been studied at liquid-^{4}He temperatures. The temperature dependence of the low-field resistance indicates that the conduction is due to variable-range hopping,

which dominates at the lowest temperatures, and ionized-impurity conduction, which becomes important at the highest temperatures. The observed nonlinearities of dc I-V curves are consistent with the predictions for variable-range hopping. In addition, a carrier relaxation time significantly larger than the thermal and RC time constants has been observed in the more lightly doped thermometers. Implications of these phenomena for the use of germanium thermometers in absolute measurements of temperature, infrared radiation, exotic particles, and heat capacity are discussed.

22794 **Acoustic data transmission through a drill string.** Drumheller, D.S. (to US Dept. of Energy). US Patent Application 7-184,326. 21 Apr 1988. 80p. Contract AC04-76DP00789. DE89009602 NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009602/JAW.

Acoustical signals are transmitted through a drill string by canceling upward moving acoustical noise and by preconditioning the data in recognition of the comb filter impedance characteristics of the drill string. 5 figs.

22795 **The U.S. Department of Energy SARP review training program.** Mauck, C.J. (U.S. Dept. of Energy, Germantown, MD (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 152-155(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

In support of its radioactive material packaging certification program, the U.S. Department of Energy (DOE) has established a special training workshop. The purpose of the two-week workshop is to develop skills in reviewing Safety Analysis Reports for Packagings (SARPs) and performing confirmatory analyses. The workshop, conducted by the Lawrence Livermore National Laboratory (LLNL) for DOE, is divided into two parts: methods of review and methods of analysis. The sessions covering methods of review are based on the DOE document, "Packaging Review Guide for Reviewing Safety Analysis Reports for Packagings" (PRG). The sessions cover relevant DOE Orders and all areas of review in the applicable Nuclear Regulatory Commission (NRC) Regulatory Guides. The technical areas addressed include structural and thermal behavior, materials, shielding, criticality, and containment. The course sessions on methods of analysis provide hands-on experience in the use of calculational methods and codes for reviewing SARPs. Analytical techniques and computer codes are discussed and sample problems are worked. Homework is assigned each night and over the included weekend; at the conclusion, a comprehensive take-home examination is given requiring six to ten hours to complete.

22796 **The procedures used to review safety analysis reports for packagings submitted to the U.S. Department of Energy for certification.** Popper, G.F.; Raske, D.T.; Turula, P. (Argonne National Lab., Argonne, IL (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 166-171(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

This paper presents an overview of the procedures used at Argonne National Laboratory (ANL) to review Safety Analysis Reports for Packagings (SARPs) submitted to the U.S. Department of Energy (DOE) for issuance of a Certificate of Compliance. Because the various elements of the SARP review must be synergetic for the safe operation and use of the packaging, the review must be a team effort, with all disciplines cooperating in all phases of the process. This paper emphasizes the structural and materials aspects of the review process, but the general approach presented is representative of all the disciplines involved. Some of the specific issues and problems encountered during typical reviews are discussed.

4203 Lasers

REFER ALSO TO CITATION(S) 23049, 23865, 23866

22797 **(DOE/ER/13788—T1) The chirped-pulse free-electron laser: Final technical report, September 1987--October 1988.** Moore, G.T. (New Mexico Univ., Albuquerque (USA). Center for Advanced Studies). Jan 1989. Contract FG04-87ER13788. 28p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009041/JAW.

This is the final report of a theoretical and numerical investigation into the operation of pulsed free-electron lasers in which the electron energy depends on the time of injection into the wiggler. Such energy "chirping" over each of a train of electron micropulses injected into an FEL oscillator is expected to give rise to a laser pulse inside the optical resonator with a chirped carrier frequency ω/sub s/({tau}). 8 refs., 7 figs.

22798 **(LA-UR—89-622) Vaporization and recondensation in propagation and imaging of laser beams.** Zardecki, A.; Gerstl, S.A.W. (Los Alamos National Lab., NM (USA)). Feb 1989. Contract W-7405-ENG-36. 11p. (CONF-890358—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008014/JAW.

From Society of Photo-Instrumentation Engineers conference on applications of artificial intelligence; Orlando, FL, USA (28 Mar 1989).

To study the response of a medium to a localized disturbance, the coupled aerosol-beam equations---in which the dominant interactions are diffusive mass transport and conductive energy transport---are solved numerically, thus giving the spatio-temporal behavior of the propagating beam and the irradiated aerosols. In the context of the cloud clearing problem, a deleterious effect of recondensation is assessed. We examine the effect of turbulence on the distribution of droplet sizes during the recondensation. Results relevant to propagation and imaging are given. 12 refs., 10 figs.

22799 **(LBL—26783-Vol.2) Report of the workshop on scientific opportunities for infrared free-electron lasers: Volume 2.** (Lawrence Berkeley Lab., CA (USA)). Feb 1989. Contract AC03-76SF00098;AC02-76CH00016. 345p. (CONF-8810126—). NTIS, PC A15 - OSTI. Order Number DE89009106/JAW.

From Infrared free electron laser applications; Berkeley, CA, USA (31 Oct 1988).

The workshop on Scientific Opportunities for Infrared Free-electron Lasers was held on October 31--November 1, 1988, in Berkeley, California. The objective of the workshop was to bring together chemists, physicists, device physicists and engineers to review the current status of IRFEL technology and to discuss the scientific opportunities that will emerge because of the unique characteristics of these devices. The contents of this report serve as a fair testimony that the objective was accomplished in excellent form.

22800 **(SAND—88-3099C) All-implanted planar-buried-heterostructure graded-index separate-confinement-heterostructure laser in GaAs/AlGaAs.** Vawter, G.A.; Myers, D.R.; Brennan, T.M.; Hammons, B.E. (Sandia National Labs., Albuquerque, NM (USA)). [1988]. Contract AC04-76DP00789. 7p. (CONF-890423—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89002892/JAW.

From CLEO '89: conference on lasers and electro optics; Baltimore, MD, USA (24 Apr 1989).

We report operation of an all-implanted planar-buried heterostructure graded-index separate-confinement-heterostructure laser in GaAs/AlGaAs. The structure utilizes only Si and Be ion-implantation and rapid thermal annealing to form both the reverse blocking junctions and the buried-heterostructure waveguide. 1 ref., 2 figs.

22801 (SAND—88-7162C) Kinetic studies of the electron-beam-pumped ArF laser. Genoni, T.C.; Wright, L.A.; Bida, T.A. (Mission Research Corp., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 4p. (CONF-890423—4). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004041/JAW.

From CLEO '89: conference on lasers and electro optics; Baltimore, MD, USA (24 Apr 1989).

Results from ArF kinetics calculations -- including vibrational relaxation, B/C state mixing and amplified spontaneous emission --are compared to experiments measuring extracted intensity and fluorescence yield. An efficient two-stage amplifier is then designed. 3 refs.

22802 (UCRL—99077) Tunable chromium lasers. Chase, L.L.; Payne, S.A. (Lawrence Livermore National Lab., CA (USA)). Jan 1989. Contract W-7405-ENG-48. 9p. (CONF-890145—23). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008814/JAW.

From SPIE conference on optics, electro-optics and laser applications in science and engineering: OE/LASE '89; Los Angeles, CA, USA (15 Jan 1989).

During the decade that has passed since the discovery of the alexandrite laser, many other tunable vibronic sideband lasers based on Cr^{3+} have been developed. These lasers span the wavelength range from 700 nm to at least 1235 nm. Experimental and theoretical research has provided an understanding of the important factors that influence the performance of these Cr^{3+} lasers and other solid state vibronic lasers. The intrinsic performance levels of some of the most promising Cr^{3+} lasers are evaluated from extrapolated slope efficiency measurements. 7 refs., 4 figs., 2 tabs.

22803 Measured laser parameters for reactor-pumped He/Ar/Xe and Ar/Xe lasers. Alford, W.J.; Hays, G.N. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800). *Journal of Applied Physics;* **65**: No. 10, 3760-3766(15 May 1989).

We have measured laser parameters for reactor pumping of He/Ar/Xe gas mixtures lasing predominantly at 2.03 μm and Ar/Xe mixtures lasing predominantly at 1.73 μm. Gains as high as {similar←to}3%/cm have been measured in He/Ar/Xe at pump powers of {similar←to}200 W/cm^3. Both systems exhibit small distributed losses. Intrinsic laser energy efficiencies as high as 2.4% (3.0%) have been observed for He/Ar/Xe (Ar/Xe). These efficiencies are the highest reported for reactor-pumped lasers.

22804 Third-order optical sum-frequency generation in micrometer-sized liquid droplets. Acker, W.P.; Leach, D.H.; Chang, R.K. (Section of Applied Physics and Center for Laser Diagnostics, Yale University, New Haven, Connecticut 06520). *Optics Letters;* **14**: No. 8, 402-404(15 Apr 1989).

A series of discrete emission peaks is detected from single micrometer-sized droplets. The series starts at the blue third harmonic of the input IR radiation and extends to the red as a result of four-wave mixing of the input radiation and the multiorder stimulated-Raman-scattering radiation. The detected third-harmonic intensity from a single liquid droplet is several orders of magnitude larger than that from an optical cell containing the same liquid.

22805 Dye-laser equation with saturation and its best Fokker-Planck equation. Peacock-Lopez, E.; Javier de la Rubia, F.; West, B.J.; Lindenberg, K. (Department of Chemistry, B-040, and Institute for Nonlinear Science, R-002, University of California San Diego, La Jolla, California 92093). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 8, 4026-4035(15 Apr 1989).

We carry out numerical simulations of the evolution and steady-state properties of a dye laser operating near resonance. The model we use is fully two dimensional (i.e., it includes the intensity and the phase of the radiation) and does not involve the usual low-intensity expansions commonly used in the literature. The equation for the complex electric field is driven by white additive noise (quantum fluctuations due to spontaneous emission) and by colored multiplicative noise (fluctuations of the gain parameter). We note that the simulations agree with the experimental results of Zhu, Yu, and Roy [Phys. Rev. A 34, 4333 (1986)] for parameter values used in their experiments. We compare the simulation results with predictions of the "best Fokker-Planck equation" (BFPE) for the steady-state distribution of the laser intensity and find remarkable quantitative agreement for large ranges of parameters values, even for values that are in principle beyond the range of validity of this equation. We conclude that the BFPE can be safely invoked to make predictions for this system.

22806 Spectral structures of supermodes in free-electron lasers. Dattoli, G.; Torre, A.; Mezi, L.; Gallardo, J.C.; Caloi, R. (Dipartimento TIB: Divisione Fisica Applicata, Comitato Nazionale per la Ricerca e per lo Sviluppo dell'Energia Nucleare e delle Energia Alternative, Centro Ricerche Energia Frascati, Casell Postale 65, 00044 Frascati, Rome, Italy). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 8, 4281-4283(15 Apr 1989).

In this Brief Report we derive analytically the spectral structure of supermodes in the long electron bunch limit.

22807 High-efficiency, continuous-wave, epitaxial surface-emitting laser with pseudomorphic InGaAs quantum wells. Gourley, P.L.; Lyo, S.K.; Dawson, L.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **54**: No. 15, 1397-1399(10 Apr 1989).

We report the first continuous-wave (cw) photopumped operation of surface-emitting lasers comprising pseudomorphic InGaAs quantum wells. The lasers were grown by molecular beam epitaxy and incorporate epitaxial quarter-wave AlAs/GaAs mirrors surrounding an active region. In the active region, 50 A InGaAs quantum wells are distributed with half-wave periodicity to center on cavity standing wave maxima. Lasing is observed from 78 to 250 K in the spectral range 920--950 nm, where the GaAs substrate is transparent. Thresholds were as low as 1.5 x 10^4 W/cm^2, and overall (differential) output power efficiency was as high as 35% (85%) with up to 60 mW in a low divergence beam. Both periodic gain and biaxial compressive layer strain contribute to the reduced lasing threshold. The laser gain length is only 550 A (11 quantum wells). The possibility of surface-emitting lasing in single quantum wells is discussed.

22808 Nonlinear Gaussian expansions of stochastic processes: super-Gaussian effects in coherent anti-Stokes Raman spectroscopy. Lau, A.M.F.; Farrow, R.L. (Combustion Research Facility, Sandia National Laboratories, Livermore, California 94550). *Optics Letters;* **14**: No. 7, 367-369(1 Apr 1989).

We propose a new approach to the analysis of stochastic processes (such as fluctuating laser fields) with super-Gaussian statistics: the expansion of stochastic processes in terms of first and higher powers of Gaussian components, which are used like a basis set. This approach is applied to treat the super-Gaussian correlation effects observed in coherent anti-Stokes Raman scattering experiments using frequency-doubled pump laser fields. Our results give much better agreement with experimental data than previous theories do.

22809 Two topological phases in optics by means of a nonplanar Mach-Zehnder interferometer. Jiao, H.; Wilkinson, S.R.; Chiao, R.Y.; Nathel, H. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 7, 3475-3486(1 Apr 1989).

Experiments on two of the recent manifestations of Berry's phases in optics and their mutual influence are reported. The first is the phase that arises from a cycling in the directions of a beam of light, so that the tip of the spin vector of a photon in this beam traces out a closed curve on the sphere of spin directions. The second is Pancharatnam's phase that arises from a cycling in the polarization states of the light while keeping the direction of the beam of light fixed, so that the tip of the Stokes vector traces out a closed curve on the Poincare sphere. What happens when the two phases are combined in the same experiment is examined. We find that the two phases are additive if we use the notion of a generalized Poincare sphere. The classical theory of the effect based on the Jones calculus is presented, as well as a general analysis of

Berry's phases for Maxwell's equations. The signs of these phases have been determined experimentally, and they agree with theory.

22810 **Mode competition and control in free-electron-laser oscillators.** Antonsen T.M. Jr.; Levush, B. (Laboratory for Plasma Research, University of Maryland, College Park, Maryland 20742). *Physical Review Letters;* **62**: No. 13, 1488-1491(27 Mar 1989).

The problem of longitudinal mode competition in free-electron lasers is addressed. It is shown that for small enough ratios of the current to output coupling coefficient many single-mode states are possible. However, the time required to reach these states becomes extremely long for typical devices. Before reaching a single-mode state the radiation field becomes relatively constant in amplitude with modulations of its phase. Finally, a simple method for reaching the stable single-mode state with maximum efficiency is suggested.

22811 **Index-guided arrays with a large index step.** Hadley, G.R. (Division 1124, Sandia National Laboratories, Albuquerque, New Mexico 87185). *Optics Letters;* **14**: No. 6, 308-310(15 Mar 1989).

The mode-selection mechanism operative in a new class of large-index-step index-guided arrays is elucidated, and it is shown that such arrays may be designed to operate stably in the fundamental mode at high power levels. In contrast to evanescently coupled arrays, these devices operate in a new set of so-called leaky modes. The calculations demonstrate a significant discrimination between the fundamental and high-order leaky modes that is sensitive to the widths of the high-index coupling regions but insensitive to the drive current. This resulting mode discrimination combined with the inherently large index step present in these devices should allow them to operate stably under cw conditions and/or at high drive currents.

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REFER ALSO TO CITATION(S) 22458, 23037, 23051, 23367

22812 **(AEEW-M—2382) Comparison of the results of Harwell and Winfrith post-dryout experiments.** Swinnerton, D.; Pearson, K.G.; Ralph, J.C. (UKAEA Atomic Energy Establishment, Winfrith (UK). Safety and Engineering Science Division; UKAEA Harwell Lab. Thermal Hydraulics Div.). (UKAEA Atomic Energy Establishment, Winfrith (UK). Safety and Engineering Science Div.). Jan 1988. 29p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705608/JAW.

Steady state post dryout heat transfer data have been obtained for vertical flow inside a tube of inside diameter 10 mm and length 920 mm both at Winfrith and Harwell. The data were obtained using the "hot patch" technique in which indirectly heated copper blocks brazed onto either end of the test section tube operate at above the critical heat flux. These hot patches stabilise the quench front beyond the tube, which may then be operated in post dryout down to relatively low heat fluxes and steam qualities. Many of the comparisons between the two sets of data are good, but in some cases, when the inlet subcooling is high, the Winfrith tube temperatures are hotter by up to 100/sup 0/C close to the test section inlet. Further downstream towards the tube outlet Harwell and Winfrith temperature measurements again tend to agree. It is considered most unlikely that experimental error could account for these differences. Furthermore, Winfrith tests have shown that measured tube heat fluxes are sensitive to the inlet flow pattern and the steam quality at the hot patch outlet. The Winfrith test section had a 90/sup 0/ bend immediately upstream of the inlet hot patch, while the Harwell inlet was straight. The Winfrith hot patch braze is also known to have been cracked, affecting the hot patch heat flux profile and its outlet quality. It is suggested that either of these two effects may produce earlier disruption of an inverted annular flow pattern in the Winfrith test section, giving poorer heat transfer and higher tube temperatures in this region.

22813 **(AEEW-M—2512) Modelling vertical counter-current flow limitation using RELAP5/MOD2.** Dillistone, M.J.; Richards, C.G. (UKAEA Atomic Energy Establishment, Winfrith (UK). Reactor Systems Analysis Div.). May 1988. 28p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705944/JAW.

This report describes and analyses the results of a study in which a particular code, RELAP5/MOD2, was used to simulate vertical counter-current flow limitation (CCFL). The purpose of the study was to see how well RELAP5/MOD2 could predict CCFL in a straight vertical pipe. Attention was focussed on the code's prediction of the "flooding-curve", i.e. the curve obtained by plotting the mass flow of liquid able to get down the pipe under gravity, against the mass flow of steam being forced up the pipe against it. RELAP5 overpredicted these liquid downflows by more than an order of magnitude, and the reason for this is shown. When modified, the code was able to predict the liquid downflow well at high gas flow-rates, but still overestimated it by roughly a factor of three at lower gas flow rates. Part 3 of the report describes how the code was further modified so that the liquid downflow was determined entirely by the code's standard annular-mist interphase friction correlation. Then the agreement with experimental data was good at low and high gas flow rates. Conclusions and recommendations are made about the code, the vertical flow-regime map and about void donoring at junctions.

22814 **(AEEW-R—2192) Steady state post dryout experiments at low quality and medium pressure.** Swinnerton, D; Pearson, K.G.; Hood, M.L. (UKAEA Atomic Energy Establishment, Winfrith (UK). Safety and Engineering Science Div.). Jan 1988. 115p. NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88705609/JAW.

Steady state post dryout heat transfer data have been obtained for vertical flow inside a tube of inside diameter 10 mm and length 920 mm. The data were obtained using the "hot patch" technique in which indirectly heated copper blocks brazed onto either end of the test section tube operate at above the critical heat flux. These hot patches stabilise the quench front beyond the tube, which may then be operated in post dryout down to relatively low heat fluxes and steam qualities. The range of data obtained was limited by the ability of the hot patches to prevent the quench front entering the tube. In upflow data were obtained at up to 200 kg/m/sup 2/s at 20 bar and 1000 kg/m/sup 2/s at 5 bar. Downflow data were restricted to 200 kg/m/sup 2/s at 5 bar and 500 kg/m/sup 2/s at 2 bar. In many runs it was possible to measure vapour superheat at the tube exit. Typical results are presented and their trends discussed. These trends may be explained qualitatively by assuming that in upflow the flow pattern is initially one of inverted annular flow which gradually breaks down into dispersed flow. In upflow, raising the pressure improved heat transfer along the whole length of the test section. Raising the flow rate also improved heat transfer. Heat transfer in downflow was very much worse than in upflow. The data are compared with several models and correlations.

22815 **(AEEW-R—2267) Steady state post-dryout experiments at low quality and medium pressure. Data report.** Swinnerton, D.; Hood, M.L.; Pearson, K.G. (UKAEA Atomic Energy Establishment, Winfrith (UK). Safety and Engineering Science Div.). Jun 1988. 130p. NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS. Order Number DE88705611/JAW.

Steady state post-dryout data have been obtained for both upflow and downflow in a 9.75 mm diameter, 920 mm long vertical tube, by means of the "hot patch" technique. This method uses indirectly heated copper blocks brazed onto either end of the test section tube. The blocks operate above the critical heat flux and stabilise the quench front beyond the tube, which may then be operated down to low heat fluxes and thermodynamic qualities. The range of data was limited by the ability of the hot patches to hold the quench front. In upflow data were obtained up to 200 kg m/sup -2/ s/sup -1/ at 20 bar and 1000 kg m/sup -2/ s/sup -1/ at 5 bar. Downflow operation was possible up to 200 kg m/sup -2/ s/sup -1/ at 5 bar and 500 kg m/sup -2/ s/sup -1/ at 2 bar. The majority of the data were obtained with an inlet subcooling of about 5/sup 0/

C, although subcoolings as high as 26/sup 0/C were used. Heat fluxes were in the range 0.5 to 50 Wcm/sup -2/ while outlet equilibrium qualities were between zero and 60%. This report gives a full listing of the data from the test series together with such details as are necessary to permit further analysis.

22816 **(ANL/PPRNT—39-125) Condensation of steam on the underside of a horizontal surface in the presence of air and helium.** Stein, R.P.; Cho, D.H.; Lambert, G.A. (Argonne National Lab., IL (USA)). [1989]. Contract W-31109-ENG-38. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008389/JAW.

Experiments and data analysis for the condensation of steam on the underside of a horizontal surface in a closed vessel are described. Previously reported results for film condensation with air as a noncondensable gas are reviewed and compared with new data with helium as the noncondensable in the same apparatus. Observations, including photographs of the condensate configurations, related to the occurrence of dropwise condensation are also discussed. It is noted that data reproducibility over long periods of time were possible only with film condensation and that with dropwise condensation condensing surface temperatures exhibited large nonuniformities and random fluctuations with time. The well known mass transfer calculational model for accounting for the presence of noncondensable gases had been shown previously to be successful with air. The same model when applied to the helium data was not successful except for small gas contents. It appears that the suppression of convection that would be expected to occur with the less dense gas is counteracted by convection induced by fog or mist formation. 14 refs.

22817 **(DOE/ER/13759—2) Solidification of binary substances in rectangular and cylindrical cavities.** Christenson, M.S.; Incropera, F.P. (Purdue Univ., Lafayette, IN (USA). Heat Transfer Lab.). Feb 1989. Contract FG02-87ER13759. 130p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008883/JAW.

An experimental study of solidification has been performed for binary solutions in rectangular and cylindrical cavities with varying initial concentration and thermal boundary conditions. Solutally driven flows were found to strongly influence solidification rates, localized remelting, and macroscopic solute redistribution. Control of these flows can be effected through selection of the thermal conditions imposed on the solidification process. Comparisons between experimental and numerical results for solidification of a binary NH_4CL–H_2O solution is in a rectangular cavity have been made using a newly developed continuum model. Qualitative and quantitative agreement was found to exist and several experimentally unobservable features of the solidification process were highlighted by means of the numerical model. 43 refs., 57 figs., 2 tabs.

22818 **(FEI—1889) Investigation of tube diameter effect on the burnout in different flow regimes.** Boltenko, Eh.A.; Vinogradov, V.N.; Katan, I.B.; Pomet'ko, R.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1988. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706148/JAW.

The results of experimental research of diameter effect on the value of density of critical heat flux Q/sub cr./ during cryogenic agent Hladon-12 flow in evenly heated tubes and thermal release, are presented. The analysis of data has permitted to single out the zones of various effects of diameter corresponding to various flow regimes. Using the data on the heat transfer crisis in water flow the dependences describing the data for tubes with the 8 mm diameter and corrections for other diameters are obtained. Using the data on Hladon-12 the expression for relaxation length not depending on tube diameter and permitting to describe the data on crisis in tubes during nonuniform heating is obtained. 13 refs.; 6 figs.

22819 **(FEI—1895) Calculational investigation of heat transfer non-stationary local characteristics when boiling in a tube.** Kanukhina, S.V.; Ivanova, T.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1988. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706149/JAW.

The results of numerical studies of nonstationary conjugation of the heat transfer problem in a two-phase flow in a tube in the mode of initial boiling, are presented. The research is made on the basis of the mathematical model of the homogeneous flow. The calculations are performed in dimensionless variables by the differential method. The differential system is solved by the H-factorization method. 4 refs.; 8 figs.

22820 **(FEI—1899) Phase velocity distribution in cross section of nucleus of water-steam annular-dispersion flow.** Kirillov, P.L.; Muranov, Yu.V.; Turchin, N.M.; Shtejn, Yu.Yu.; Shumskij, R.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1988. 23p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706150/JAW.

The result of measuring linear and flow rates of up-wise steam-water dispersed circular flow in 17 mm internal diameter tube, are presented. The measurement are performed using tube isokinetic sampler equipped with adiabatic phase separator washed and thermostattically controlled by the flow studied. The studies are performed at pressures of 4.9, 6.86, 9.8 and 13.7 MPa in the range of flow rate from 500 to 1500 kg/m/sup 2/s. The main attention in the process of collection of experimental data is paid to the effect of different parameters of flow on the nature of phase distribution in flow cross section. Namely, the effect on the distance from the end of the heated zone to the measurement place on it is studied. This length of the adiabatic section varied from 0 to 2 m. 5 refs.; 3 figs.; 2 tabs.

22821 **(FhG-IzfP—860142-TW) Multifrequency eddy current testing, process optimisation for steam generator heating tube testing. Phase 2. Nonlinear description of the signal loci, dynamics of the signal loci. Final report.** Becker, R.; Betzold, K. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 29 Aug 1986. 100p. (In German). Fraunhofer-Institut fuer Zerstoerungsfreie Pruefverfahren, Saarbruecken (Germany, F.R.).

The aim of the project was to improve flaw detection capability and signal analysis with respect to flaw size and defect nature, for the purpose of testing the tube plates and scrap marks of the heating tubes of steam generators. Three methods of proceeding were developed, realized and tested to that end. 1. The nonlinear curve-branch of the spurious signal of the tube plate and the scrap mark is specified with linear terms in the impedance planes. The measured values are linked in such a way that the residual signals of the entire signal pattern of the noise source are reduced to a minimum with regard to the signal amplitude of the defect types. 2. The signal pattern of the noise source is described directly with the help of polynomials of the second degree, and the measured values are linked quadratically. 3. The time and space dependence of the dynamic signal flow diagram is evaluated. The signal dynamic, as an additional decision criterion, is evaluated along with the angle determination at the classification level, so that hole-like cracks can be distinguished from longitudinal cracks. Additional information is obtained for the detection of traverse cracks and the isolation of superposed defects. An operational multifrequency testing apparatus with which the signal evaluations and signal connections described above can be effected is available. The choice of the test frequencies used consitutes a sensitive factor for successful signal evaluation. In this connection, an optimization software comes in which is implemented on an external computer. On the whole then, a whole lot of measured values, characteristic data and signal parameters are available for the interpretation of the test results.

22822 **(JAERI-M—88-208) Numerical study on laminar circular jet of carbonic acid gas discharging into stagnant air.** Fumizawa, Motoo; Hishida, Makoto; Kunugi, Tomoaki. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Oct 1988. 32p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757249/JAW.

The flow behavior of the circular jet of two component gases is the most fundamental study in that of multi-component gases. The objective of present study is to investigate numerically the fluid flow and diffusion behavior of laminar circular jet of carbonic acid gas (CO/sub 2/) discharging into stagnant air along gravity force. The flow and CO/sub 2/ mass fraction distribution analysis was carried out by modified TEAM (Turbulent Elliptic Algorithm Manchester) code which solved elliptic equations using staggered grid system. As the result, the followings were obtained in the range of Froude number Fr = 0.007 - 0.7: (1) Axial velocity increased along down stream because the jet accelerated by gravity force. (2) It was necessary to obtain accurate radial velocity to evaluate CO/sub 2/ mass fraction distribution. (3) In the case of low Froude number, half radii of axial velocity and CO/sub 2/ mass fraction distribution increased along the flow direction as well as the conventional buoyant jet. In the case of relatively high Froude number, however, half radius of axial velocity distribution was constant and half radius of CO/sub 2/ mass fraction decreased along the flow direction.

22823 **(JINR—8-87-856) Some special features of heat transfer to He-I and He-II at boiling in a large volume and under embarassed conditions.** Arkharov, A.M.; Derendyaev, Yu.S.; Pryanichnikov, V.I. (Moskovskoe Vysshee Tekhnicheskoe Uchilishche (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706219/JAW.

The intensity of heat transfer to He-I and He-II was investigated, and method for numerical simulation of heat transfer under "embarrased" conditions using experimental data by modelling the conditions of operation of superconducting cavity was developed. It is established that under "embarassed" conditions heat transfer to He-I is lower by a factor of 7, and to He-II - by twice, as compared to normal ones. 11 refs.; 3 figs.

22824 **(LA-UR—89-264) Capacitance matrix method in TRAC and MELPROG.** Steinke, R.G.; Dearing, J.F. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 10p. (CONF-890408—5). NTIS, PC A02/MF A01 - OSTI; GPO Dep. Order Number DE89006557/JAW.

From Advances in nuclear engineering computation and radiation shielding; Santa Fe, NM, USA (9 Apr 1989).

The capacitance matrix method has been used in the TRAC and MELPROG transient, thermal-hydraulic, safety-analysis computer programs to solve the multi-dimensional-vessel matrix equations. A full-matrix solver rather than a more efficient banded-matrix solver was used previously because of nonzero elements lying outside the matrix bandwidth. These outlying nonzero elements result from vessel external and internal pipe flow channels connecting non-adjacent cells in the multidimensional vessel component. The capacitance matrix method provides a more efficient solution algorithm by solving the banded portion of the vessel-matrix equation with a banded-matrix solver. The effect of the nonzero outlying elements on that solution is accounted for through matrix algebra and a lower order capacitance-matrix equation solution that modifies the banded-matrix solution to give the full-matrix solution. 5 refs., 2 figs.

22825 **(NP—9770328) Heat transfer and pressure loss in one-side heated, inclined and internally rifled tubes. Final report.** Kastner, W.; Kefer, V.; Koehler, W.; Kraetzer, W. (Kraftwerk Union A.G., Erlangen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Oct 1988. 152p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE89770328/JAW.

The once-through steam generator concept is an economical solution also for the waste heat boiler behind a coal gasification of a modern combined-cycle power plant. For an optimized design and a well-grounded comparison of the two variants evaporator with helical coiled tubes, evaporator with vertical installed internally rifled tubes theoretical work was performed and calculation procedures were developed to determine the heat transfer conditions and pressure losses in inclined smooth tubes, one-side heated smooth tubes, internally rifled tubes. This work was based on extensive experimental investigations in a high-pressure loop covering the whole range of interesting parameters for waste heat boilers, i.e. pressures between 25 and 250 bar, mass flow rates between 300 and 2500 kg/m/sup 2/s and heat fluxes between 150 and 600 kW/m/sup 2/. A total amount of approximately 1800 tests was performed using tubes with various diameters (12.5 to 24.3 mm). (orig.) With 47 refs., 3 tabs., 67 figs.

22826 **(SAND—89-0366C) A vortex panel analysis of circular-arc bluff-bodies in unsteady flow.** Strickland, J.H. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 28p. (CONF-8904118—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007141/JAW.

From 10. AIAA aerodynamic decelerator systems technical conference; Cocoa Beach, FL, USA (18 Apr 1989).

A method which is capable of calculating the unsteady flow field around circular-arc bluff bodies of zero thickness is presented. This method utilizes linear vortex panels to model the body surface and a portion of the wake surfaces. Discrete vortices are used to model the remainder of the wake surfaces. Separation is assumed to occur at the sharp edges of the bodies. Numerical results for circular-arc bodies with included angles of less than 180{degree} are compared with experimental data and found to be in good agreement. 31 refs., 15 figs.

22827 **(SERI/TP—253-3426) Heat transfer and pressure drop measurements in an air/molten salt direct-contact heat exchanger.** Bohn, M.S. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1988. Contract AC02-83CH10093. 10p. (CONF-890436—7). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000837/JAW.

From American Society of Mechanical Engineers solar energy conference; San Diego, CA, USA (2 Apr 1989).

This paper presents a comparison of experimental data with a recently published model of heat exchange in irrigated packed beds. Heat transfer and pressure drop were measured in a 150 mm (ID) column with a 610-mm bed of metal Pall rings. Molten nitrate salt and preheated air were the working fluids with a salt inlet temperature of approximately 440{degree}C and air inlet temperatures of approximately 230{degree}C. A comparison between the experimental data and the heat transfer model is made on the basis of heat transfer from the salt. For the range of air and salt flow rates tested, 0.3 to 1.2 kg/m^2 s air flow and 6 to 18 kg/m^2 s salt flow, the data agree with the model within 22% standard deviation. In addition, a model for the column pressure drop was validated, agreeing with the experimental data within 18% standard deviation over the range of column pressure drop from 40 to 1250 Pa/m. 25 refs., 7 figs., 2 tabs.

22828 **Particle velocity and stress gage measurements in spherical diverging flow.** Larson, D.B.; Stout, R.B. (Lawrence Livermore National Lab., Livermore, CA (US)). pp v of Techniques and theory of stress measurements for shock wave applications. Stout, R.B.; Norwood, F.R.; Fourney, M.E. Houston, TX; Industrial Presentations Inc. (1987). (CONF-8706186—).

From ASME applied mechanics, bioengineering and fluid engineering conference; Cincinnati, OH, USA (14 Jun 1987).

Chemical explosions were used to generate spherically diverging stress waves in polymethylmethacrylate (PMMA). Piezoresistance gages of several different designs were placed in the PMMA radially from the spherical energy source. Two basic types of piezo-resistance gages were used. One type was placed on backing material and then glued directly to the PMMA while the other type was placed on backing material and then enclosed in a fluid cavity which was attached to the PMMA. Gages were oriented normal to the direction of the shock front. In order to interpret the

piezoresistance gage measurements and to obtain a complete set of data for numerical calculations, particle velocity was also measured at several radial positions from the explosion. Results from an analysis of piezoresistance gage response in a multi-component stress-strain field compared well with the experimental measurements for the triple material gage.

22829 **Developments in measurement techniques for shock-loaded solids.** Chhabildas, L.C.; Graham, R.A. (Sandia National Labs., Albuquerque, NM (US)). pp v of Techniques and theory of stress measurements for shock wave applications. Stout, R.B.; Norwood, F.R.; Fourney, M.E. Houston, TX; Industrial Presentations Inc. (1987). (CONF-8706186—).

From ASME applied mechanics, bioengineering and fluid engineering conference; Cincinnati, OH, USA (14 Jun 1987).

Developments in measurement technique for study of wave profiles in shock-loaded solids over the past decade are reviewed and their influence examined. It is found that this period is characterized by considerable activity which has been concentrated on significant improvements to earlier developments. The most influential instrumental developments are noted and some perspective on the nature of the development of shock instrumentation is presented. An extensive reference list is included.

4205 Materials Testing

REFER ALSO TO CITATION(S) 21775, 22094, 22486, 22601

22830 **(CEA-R—5472) Numeric ultrasonic image processing method: application to non-destructive testing of stainless austenitic steel welds.** Corneloup, G. (Institut National des Sciences Appliquees (INSA), 69 - Villeurbanne (France); CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France)). Sep 1988. 273p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88757184/JAW.

A bibliographic research on the means used to improve the ultrasonic inspection of heterogeneous materials such as stainless austenitic steel welds has shown, taking into account the first analysis, a signal assembly in the form of an image (space, time) which carries an original solution to fault detection in highly noisy environments. A numeric grey-level ultrasonic image processing detection method is proposed based on the research of a certain determinism, in the way which the ultrasonic image evolves in space and time in the presence of a defect: the first criterion studies the horizontal stability of the gradients in the image and the second takes into account the time-transient nature of the defect echo. A very important rise in the signal-to-noise ratio obtained in welding inspections evidencing defects (real and artificial) is shown with the help of a computerized ultrasonic image processing/management system, developed for this application.

22831 **(DOE/ER/45251—T2) NMR characterization of porous structures: Ceramics and sandstones: Renewal proposal progress report, 15 May 1986--To present.** Halperin, W.P. (Northwestern Univ., Evanston, IL (USA). Dept. of Physics and Astronomy). Aug 1988. Contract FG02-86ER45251. 17p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009148/JAW.

There has recently been considerable attention drawn to the potential for NMR methods in quantitative non-destructive evaluation of porous structures: notably the characterization of ceramic green bodies, porous glasses, cementitious materials, and natural geological porous solids, such as sandstones and clays. The purpose of the present grant has been to establish these methods and test the theory; to apply them in the characterization of a variety of materials both model porous media and some that are technologically relevant; and very importantly, to explore the limitations of the NMR approach to pore structure determination. The potential of the method resides in the fact that it is non-destructive, quick to perform, covers a wide range of pore size from tens of angstroms to tens of microns, yet it can be applied to relatively small amounts of materials, < 1 g, without undue constraint as to material type provided that it is non-metallic and not magnetized. Although this is a new program a significant portion of the proposed work has been completed and is in press or in preparation for publication. We have discovered some important results concerning porous structures that are of fundamental interest to basic science and which put NMR relaxation analysis on solid footing. We have demonstrated important technical applications of NMR. 11 refs.

22832 **(EGG-PHY—8413) Evaluation of strains in a U-bend specimen by neutron diffraction.** Schmunk, R.E.; Harker, Y.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1989. Contract AC07-76ID01570;W-31109-ENG-38. 31p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009738/JAW.

Neutron diffraction measurements have been made on a 304 stainless steel U-bend specimen using the General Purpose Powder Diffractometer on the Intense Pulsed Neutron Source at Argonne National Laboratory. This experiment was undertaken as a demonstration to show the capabilities of neutron diffraction for the evaluation of strain fields in a stressed specimen. Collimation masks were positioned around the specimen to define the volume from which scattering was observed. Data were obtained from five different positions through the U-bend thickness by shifting the specimen position in the incident neutron beam between data runs. Diffraction data were analyzed for six different crystallographic planes for each data run: (111), (200), (220), (311), (331) and (420). Although the data clearly show variations in strain vs position, additional runs would be needed to completely map the strain field through the thickness and some improvement in resolution would be desired. Although the data may not warrant it, a least squares procedure was applied to the strain data to obtain the principal strains, radial and transverse, as a function of position. Results obtained vary as generally expected, but additional data are needed to clarify some of the detail observed. This report is tutorial in its presentation, intended for those having no experience in neutron diffraction. Valuable experience was obtained which would be useful in planning and executing additional experiments at IPNS. 9 tabs.

22833 **(EPRI-NP—6167) A feature-based eddy-current imaging system for personal computers: Final report.** Elmo, P.M.; Shankar, R. (Electric Power Research Inst., Palo Alto, CA (USA); Jones (J.A.) Applied Research Co., Charlotte, NC (USA)). Mar 1989. 36p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

Imaging eddy current nondestructive evaluation (NDE) data on low-cost, field-deployable personal computer (PC) systems is now possible. This report describes the modification of a previously developed feature-based ultrasonic (UT) testing system for automatic eddy current (EC) inspection. This EC system was applied to flat plate and circular geometries. The PC system manipulates the eddy current probe around the part to be inspected; acquires multi-frequency, dual-channel digital data and displays images of an operator-selected channel; and utilizes advanced signal processing software to generate and display impedance-plane trajectories for all frequencies. Laboratory experiments using this eddy current test system on flaw calibration standards, induced intergranular-stress-corrosion-cracking (IGSCC) in retaining ring material coupons, and induced cracks in full size retaining rings have demonstrated the system's capability to detect surface damage. Future efforts will incorporate other problem-relevant signal processing algorithms to aid in detecting and characterizing surface-damage, such as pitting and cracking. 6 refs., 20 figs.

22834 **(FhG-IzfP—780852-TW) Flaw reconstruction from amplitude loci. Final report.** Werneyer, R.; Walte, F.; Mueller, W. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). [1988]. 122p. (In German). Fraunhofer-Institut fuer Zerstoerungsfreie Pruefverfahren, Saarbruecken (Germany, F.R.).

In ultrasonic tests with thick-walled components, only maximum amplitudes and running times have been used so far for evaluation purposes. The process presented also draws upon the dynamic behaviour of echoes for the purpose of describing the reflec-

tor. The reflection characteristics of circles, strips, spheres and cylinders are studied with the help of diffraction theory or of geometrical reflection, and amplitude response curves determined. Voluminous reflectors can successfully be distinguished from planar reflectors, where oblique positions are also permitted. The inversion of the amplitude response curve makes reconstruction possible with the help of single model reflectors. Comparative measurements with artificial reflectors in water and in solid bodies are presented.

22835 **(FhG-IzfP—870111-TW) Phased arrays ultrasonic testing of the nozzle areas of HWR pressure vessel bottom heads and PWR pressure vessel closure heads. Final report.** Gebhardt, W.; Schwarz, H.P.; Rupp, S. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 14 Mar 1988. 222p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88757356/JAW.

For the testing of nozzle areas in the bottom calotte of BWR pressure tanks as well as the cover of PWR pressure tanks, segmented ring-array probes were designed, produced as prototypes, electrically and acoustically measured and their capability to detect failures was experimentally tested. This probe was selected because it permits a three-dimensional control of the sound beam, which means that angle of squint and acoustic irradiation angle can be electronically varied independent from each other. Because the now available phased-array electronics has 24 channels, the tests started with a single ring, which is divided into 24 segments. The experiments showed, however, that despite the high amplification reserve of the probe, no sufficient failure detection was possible because of occurring dimensional data. Within the framework of redevelopment phase, the probe was modified: instead of a single ring, a double ring system was chosen, which is divided in 48 elements. The symmetry of the probe was used for the electrical connection of two individual oscillators. Thus, the sound beam can be electronically rotated; a change of the angle of squint is, for the present, only possible by mechanical movement. Experiments at the spherical bottom of the large container of the materials testing institute were carried out with this probe. The indications of most of the test reflectors, placed in the perforated zones, distinguished very clearly from the plating noise background and could be easily distinguished from the indications caused by the bore surfaces. A determination of the size of failures by detection of peak indications in form of sector-B images and compound-B images proved to be very problematic.

22836 (INIS-SU—75, pp 30-33) **Selection of layout for systems of fuel element nondestructive testing in hot chambers.** Aleshechkin, L.V.; Kuz'min, V.I. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780081/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Construction and building. Scientific-technical collection.

A method for selecting an optimal variant of layout for systems of fuel element nondestructive testing in a hot chamber, based on analysing layouts using structural formulas with regard to the system structural features, is proposed. A formalized description of the system layouts by structural formulas allows one to conduct their synthesis using a certain set of units (components) and to select optimal ones at the initial stage of design. 3 refs.; 2 figs.

22837 **(SAND—88-2891C) Corrosion monitoring with acoustic wave devices.** Sorenson, N.R.; Ricco, A.J.; Martin, S.J. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 13p. (CONF-890437—9). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005235/JAW.

From Corrosion '89; New Orleans, LA, USA (17 Apr 1989).

Acoustic wave devices have been used to study atmospheric and aqueous corrosion of thin metal films. By monitoring the change in propagation velocity of a surface acoustic wave (SAW), atmospheric corrosion by gases can be recorded. Sulfidation of copper and inhibition of the sulfidation process by organic inhibitors has been studied to demonstrate the extreme mass sensitivity of the SAW devices. By exciting the same substrate at a different frequency, a shear horizontal acoustic plate mode (SH-APM) was used to monitor corrosion of aluminum in an aqueous sodium hydroxide environment. 7 refs., 10 figs.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 21847, 21849, 21851, 21855, 22008, 22009, 22010, 22647, 23022, 23046, 23372

22838 **(CONF-881275—1) Zinc oxide varistor time response.** Modine, F.A.; Major, R.W.; Choi, S.I.; Bergman, L.B.; Silver, M.N. (Oak Ridge National Lab., TN (USA)). Feb 1989. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008234/JAW.

From American Ceramic Society conference on zinc oxide varistors: science and technology; Schenectady, NY, USA (5 Dec 1988).

The application of a voltage to a zinc oxide varistor produces transient currents that persist on a time scale extending from 10/sup {minus}8/ to 10^5 seconds at the least. The transient currents are characterized by a power-law time dependence (i.e., I =I/sub o//t/sup m/, where m is a little less than unity) and a weak temperature dependence that is described by a thermal activation energy of about 100 meV or less. The time dependence is confirmed by an ac admittance that increases as a noninteger power of the frequency [i.e., Y = K(jω)/sup m/], with Fourier theory providing the connection between the time and frequency measurements. Also, the transient currents are accompanied by changes in the ac admittance measured at fixed frequencies that reveal similar time and temperature dependencies. The transient currents are not well understood, but they are typical of the non-Debye electrical response that is found in many materials. An explanation of the transients is obtained if a distribution of relaxation times is assumed. 7 refs., 6 figs.

22839 **(CONF-8904111—5) An application specific integrated circuit for dual-axis motion control.** Zimmermann, S.D.; Satterlee, P.E. Jr.; Bouldin, D.W. (TeleRobotics International, Inc., Knoxville, TN (USA)). [1989]. Contract AC05-86ER80399. 7p. NTIS, PC A02 - OSTI. Order Number DE89007974/JAW.

From Southeastcon '89 conference and exhibition; Columbia, SC, USA (9 Apr 1989).

An Application Specific Integrated Circuit (ASIC) for dual-axis robotic motion control was designed and developed with Computer Aided Design (CAD) tools. The ASIC provides an all digital dual-axis Pulse Width Modulated (PWM) amplifier interface. The ASIC layout was produced on a SUN workstation using VLSI design tools. A standard cell library of basic digital functions and an automatic placement and autorouting program was used in the course of the design. The design was implemented in a 2-micron Scalable CMOS (SCMOS) technology through the Metal Oxide Semiconductor Implementation Service (MOSIS). The device was fabricated in both 40-pin ceramic DIP and 44-pin Plastic Leaded Chip Carrier (PLCC) packages. The dual-axis PWM controller chip was designed as part of a complete dual-arm, force-reflecting, master-slave telerobotic manipulator system and provides a 24 KHz PWM drive signal and control for a two-axis, 500-watt amplifier module. The device interfaces to a microprocessor bus and requires only 100 mW of power at 12 MHz operation. 6 refs., 5 figs.

22840 **(DOE/CE/15319—T8) [High energy semiconductor switch]: Final report for the period February 24, 1987 to February 24, 1989.** Risberg, R.L. (Risberg Power Electronics, Inc., New Berlin, WI (USA)). 24 Feb 1989. Contract FG01-87CE15319. 11p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007399/JAW.

The objective was a controller for electric motors. By operating standard Nema B induction motors at variable speed a great deal of energy is saved. This is especially true in pumping and air conditioning applications. To allow wider use of variable speed AC drives, and to provide improved performance, a better semiconductor switch was sought. This was termed the "High Energy Semiconductor Switch."

22841 **(RFP—4278) RMS and average errors resulting from pass filter characteristics in instrumentation systems.** Destefan, D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1989. Contract AC04-76DP03533. 4p. (CONF-8904110—1). NTIS, PC A02 - OSTI. Order Number DE89006622/JAW.

From IEEE instrumentation conference; Washington, DC, USA (26 Apr 1989).

Rectangular and step-like waveforms occur in many physical systems. These waveforms are passed through sensors or signal conditioners having, in many cases, low pass filter characteristics. Further, the filtered waveforms are sampled by A/D converters and the average of rms values calculated. This work presents the effects of the low pass filter characteristics on the average and rms values of these step-like waveforms. The analysis method used is presented. By way of example, this method is applied to a measurement problem and the results provided. The effects of assuming unit step excitation rather than physically realizable exponential step inputs are also discussed. Future work in this area is suggested. 3 refs., 5 figs.

22842 **(SAND—88-2951C) Static contrast enhancement layer lithography.** Renschler, C.L. (Sandia National Labs., Albuquerque, NM (USA)). [1988]. Contract AC04-76DP00789. 8p. (CONF-890401—2). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003131/JAW.

From 197. national meeting of the American Chemical Society; Dallas, TX, USA (9 Apr 1989).

The linewidths of structures patterned for microelectronic fabrication continue to decrease; 0.8 μm lines and spaces are now imaged in commercial production and much smaller features are predicted for the near future. These feature sizes have dropped significantly below the previously predicted limit of optical lithography (ca. 1.25 μm). This is due principally to a very large worldwide research effort in improved optical patterning techniques. One of the more significant developments in optical patterning has been the advent of contrast enhancement layer lithography (CEL).

22843 **(SAND—88-3440C) Electrical properties and detection methods for CMOS IC defects.** Soden, J.M.; Hawkins, C.F. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 10p. (CONF-890493—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005775/JAW.

From European test conference; Paris, France (11 Apr 1989).

Defects in CMOS ICs cause unique electrical characteristics. Digital CMOS ICs may appear to perform their terminal logic functions in spite of significant imperfections such as open or short circuits. The effects of these commonly occurring defects must be understood to develop test strategies that minimize the escape of ICs with defects that either degrade reliability or compromise circuit performance. This paper summarizes and adds new information regarding electrical properties of CMOS IC defects. The parametric or logic measurements required to detect each type of defect in a production test environment are emphasized. 46 refs., 6 figs., 5 tabs.

22844 **Ionization and current growth in N_2 at very high electric field to gas density ratios.** Gylys, V.T.; Jelenkovic, B.M.; Phelps, A.V. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Institute of Standards and Technology, Boulder, Colorado 80309-0440). *Journal of Applied Physics;* **65**: No. 9, 3369-3380(1 May 1989).

Measurements and analyses have been made of electron impact ionization and of current growth in pulsed, low-current, prebreakdown discharges in parallel-plane geometry in N_2 at very high electric field to gas density ratios E/n and low products of the gas density n and electrode separation d. The E/n range and nd ranges were $1<E/n<52$ kTd, where 1 Td = 10^{-21} V m^2, and 6 x 10/sup 18/ $<nd<3$ x 10/sup 20/ m^{-2} (or $0.02<pd<1$ Torr cm, where p is pressure) and were below breakdown values. Measurements were made of the transported charge on the time scales of electron transit, ion transit, and metastable decay. Measurements were also made of the growth of steady-state discharge currents as a function of discharge voltage. The contributions of avalanches resulting from ion- and metastable-induced secondary electrons were determined from the ratio of electron-excited N^+_2 391.4-nm emission integrated over all avalanches to the integrated emission during the laser-initiated electron pulse. Calculations based on ionization by electrons only show good agreement with the measured charge transported during the electron avalanche and with the current multiplication. Analysis of 391.4-nm emission data and of charge transported at $E/n \geq 10$ kTd and voltages near breakdown using the assumption of electron impact ionization leads to large apparent secondary electron yields at the cathode which increase significantly with nd.

22845 **Method for laser-based two-dimensional navigation system in a structured environment.** Boultinghouse, K.D.; Schoeneman, J.L.; Tise, B.L. (to Dept. of Energy, Washington, DC). US Patent 4,796,198. 3 Jan 1989. Filed date 17 Oct 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a laser-based mobile navigation system, capable of locating a mobile vehicle in a two-dimensional coordinate frame of reference in a structured environment is described, the system comprising: at least three stationary retroreflective elements spaced apart from each other at known coordinates in the two-dimensional coordinate frame of reference, one of the retroreflective elements having a distinctive retroreflection; mobile laser source means supported by the mobile vehicle for projecting a mobile narrow laser beam rotating about a mobile reference axis normal to the two-dimensional coordinate frame of reference, whereby the mobile rotating laser beam sequentially interacts with the retroreflective elements to generate corresponding retroreflections therefrom; retroreflection responsive signal generating and receiving means connected to the mobile laser source means, responsive to the retroreflections from the stationary retroreflective elements, for generating output signals corresponding to each retroreflection, retroreflection, for receiving input signals corresponding to each retroreflection, and for measuring angles corresponding to the sequentially encountered retroreflector element; and computation means cooperating with the signal generating and receiving means.

22846 **Large area directly heated lanthanum hexaboride cathode structure having predetermined emission profile.** Leung, K.N.; Gordon, K.C.; Kippenham, D.O.; Purgalis, P.; Moussa, D.; Williams, M.D.; Wilde, S.B.; West, M.D. (to Dept. of Energy, Washington, DC). US Patent 4,795,940. 3 Jan 1989. Filed date 14 Oct 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A directly heated lanthanum hexaboride cathode system is described. It consists of: a lanthanum hexaboride cathode element generally circular in shape about a central axis and having a head and base at opposite ends of a central axis, the head end having a generally planar emission surface extending radially from the axis and an outer peripheral contact surface, the cathode element having an integral, axially-elongated, tapered, intermediate body extending along the central axis between the head to the base, the intermediate body having a progressively diminishing cross-section from the head towards the base, a first electrical connector in conducting engagement with and peripherally around the contact surface on the head of the cathode element, a second electrical connector in conducting engagement with the base of the cathode element, means for establishing a flow of electrical current from one of the electrical connectors through the cathode element to the other of the electrical connectors.

22847 **Thin-film chip-to-substrate interconnect and methods for making same.** Tuckerman, D.B. (to Dept. of Energy). US Patent Application 7-202,296. 6 Jun 1988. 26p. Contract W-7405-ENG-48. DE89009657 NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009657/JAW.

Integrated circuit chips are electrically connected to a silicon wafer interconnection substrate. Thin film wiring is fabricated down bevelled edges of the chips. A subtractive wire fabrication method uses a series of masks and etching steps to form wires in a

metal layer. An additive method direct laser writes or deposits very thin lines which can then be plated up to form wires. A quasi-additive or subtractive/additive method forms a pattern of trenches to expose a metal surface which can nucleate subsequent electrolytic deposition of wires. Low inductance interconnections on a 25 micron pitch (1600 wires on a 1 cm square chip) can be produced. The thin film hybrid interconnect eliminates solder joints or welds, and minimizes the levels of metallization. Advantages include good electrical properties, very high wiring density, excellent backside contact, compactness, and high thermal and mechanical reliability. 6 figs.

22848 **Double sided circuit board and a method for its manufacture.** Lindenmeyer, C.W. (to Dept. of Energy). US Patent Application 7-182,671. 14 Apr 1988. 11p. Contract AC02-76CH03000. DE89009601 NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009601/JAW.

Conductance between the sides of a large double sided printed circuit board is provided using a method which eliminates the need for chemical immersion or photographic exposure of the entire large board. A plurality of through-holes are drilled or punched in a substratum according to the desired pattern, conductive laminae are made to adhere to both sides of the substratum covering the holes and the laminae are pressed together and permanently joined within the holes, providing conductive paths. 4 figs.

4209 Waste Processing Plants And Equipment

REFER ALSO TO CITATION(S) 21717, 21891, 21892

22849 **Municipal waste processing apparatus.** Mayberry, J.L. (to US Dept. of Energy). US Patent Application 7-180,879. 13 Apr 1988. 18p. Contract AC07-76ID01570. DE89009597 NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009597/JAW.

This invention relates to apparatus for processing municipal waste, and more particularly to vibrating mesh screen conveyor systems for removing grit, glass, and other noncombustible materials from dry municipal waste. Municipal waste must be properly processed and disposed of so that it does not create health risks to the community. Generally, municipal waste, which may be collected in garbage trucks, dumpsters, or the like, is deposited in processing areas such as landfills. Land and environmental controls imposed on landfill operators by governmental bodies have increased in recent years, however, making landfill disposal of solid waste materials more expensive. 6 figs.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 21665, 21669, 21670, 21907, 21908, 21909, 21910, 22378

22850 **(NAL-TR—973) Study on a twin valveless pulse burner. Temperature characteristics during pulse combustion.** Eguchi, Kunihisa; Kurosawa, Yoji; Gomi, Mitsuo; Saito, Kazuo. (National Aerospace Lab., Chofu, Tokyo (Japan)). Apr 1988. 11p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757176/JAW.

In order to elucidate the combustion process in a twin valveless pulse burner, temperature characteristics during pulse combustion have been studied. The temperature measurements were carried out using a CARS (coherent anti-stokes Raman spectroscopy) method with high spatial and time resolutions. The temperatures on the center line of the combustion chamber decrease simply in the direction of the downstream with small variations of the temperature. The time average maximum temperature zone existed at the center line of the upstream of the combustion chamber, and it was found to be lower about 200 to 400 K than the adiabatic flame temperature. As the fuel-air mixing rate is constant in the condition of the constant mass flux, increasing the equivalent ratio causes an extension of the high temperature zone in the direction of the downstream, and the ignition delay time becomes longer. Increasing the mass flux causes an increase in the fuel consumption, however it also causes an acceleration in mixing and brings the increase of both the exothermic density and temperature at the upstream. Active spray mixing of fuel and large temperature oscillations exist near the wall upstream of the combustion chamber. Drastic periodic oscillations in the range of 800 to 1400K exist near the air port due to the air spray in one-cycle and quick combustion, and a similar tendency is observed in the periodic oscillations of the heat release rate. (12 figs, 13 refs)

4220 Underground Engineering

22851 **(CRIE-U—87071) Recent technique for excavating rock tunnels and problems to future automation.** Shin, Koichi; Komada, Hiroya; Fujiwara, Yoshikazu. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jun 1988. 44p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756835/JAW.

Required by the compressed air storage gas turbine generation, underground high level radioactive waste disposition, etc., the underground rock caverns are estimated to be considerably demanded in future. Then, the present report discusses technical themes/problems, raised by the automation in excavating/constructing works of those caverns. Objectifying an approx. 1,000m deep underground cavern, with tunnels of approx. 5m in diameter and sinking vertical shafts of approx. 8m in diameter, located inside hard rock with a uniaxial strength of more than 1,000kgf/cm^2, the report analyzes different excavating work methods presently in use. The result of this analysis judges the automation suiting work method to be the total cross section excavation method in the case of tunneling works and the reverse circulation method in case of vertical shaft's sinking works. From now on, together with the innovation on automated excavation equipment and mechanism, the establishment of predicting technique against the geological conditions on and behind working face, and basic research, with feeding back the thus predicted information, for the optimization of operation control will be necessary. (16 figs, 12 tabs, 29 refs)

22852 **(CRIE-U—87083) Experimental study on the seepage properties in the rock discontinuity.** Shimura, Kokichi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jul 1988. 36p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756836/JAW.

In connection with utilization technologies of underground space, such as underground storage of energy and high level radioactive waste underground disposal, an experimental study was performed on the relation between the permeability of rock discontinuity and debrises, using simulated materials for the pinhole tests. Several results were obtained as follows: the permeability in the rock discontinuity was confined by the characteristics and inclusion rate of debris, and increasing the degree of inclusion rate of debris reduced the permeability of the rock; in the seepage test on the discontinuity of narrow width with the degree of 0.03-5mm, the lower permeability was observed in comparison with the theoretical values for the hydraulic gradient of 0.01 and under; a permeability of reflected discontinuity was reduced by the bend and elongation of the flow channels. Though the debrises in the rock discontinuity are one of the factors, which confine the permeability, the majority of debrises are to be cohesive or coagulated and it is concluded that the erosion of debrises is seldom happened in the extent of the ordinary ground water flow in low speed. (17 figs, 4 tabs, 3 photos, 15 refs)

4230 Marine Engineering

REFER ALSO TO CITATION(S) 22487

22853 **(SAND—88-3028) Acoustic methods for communicating through water-saturated sediments.** Costley, R.D. Jr. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1989. Contract AC04-76DP00789. 14p. NTIS, PC A14/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009003/JAW.

Basic approaches to the problem of acoustically transmitting data through saturated sediments were identified. The first method was to generate and detect compressional waves with piezoelectric

transducers. The second involved generating and detecting surface waves. The merits and shortcomings of each method were discussed. 12 refs., 10 figs., 1 tab.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 21717, 21942

43 PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 23256

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 23203, 23383, 23409

22854 **(BNL—42322) Future high energy heavy ion physics at Brookhaven.** Samios, N.P.; Ludlam, T.W. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 11p. (CONF-8809203—7). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009524/JAW.

From Quark Matter '88: 7th international conference on ultrarelativistic nucleus-nucleus collisions; Lenox, MA, USA (26 Sep 1988).

This paper discusses future heavy ion facilities and experiments at Brookhaven. The design of the relativistic heavy ion collider is particularly discussed along with detectors and experiments that will be at that facility. 9 refs., 5 figs. (LSP)

22855 **(IAE—4637/1) Stationary autoresonance electron accelerator.** Timofeev, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706158/JAW.

The possibility of developing a stationary electron accelerator based on the phenomenon of cyclotron autoresonance (autophasing) is shown. The accelerator is a chain of consequently located cells. A cell has accelerating and decelerating sections. The HF-field in decelerating sections is absent, and the stationry magnetic field decreases in the longitudinal direction. A stable acceleration of an electron beam with the 10 mA current for 1m accelerator length, 40 cm beam radius, 1 kW/cm field intensity, is possible. 1 fig.; 1 tab.

22856 (INIS-BR—1440, pp 40) **Improvements, developments and nationalizations of cyclotron.** 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22857 (INIS-BR—1440, pp 48) **Cyclotron operation.** 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22858 (INIS-SU—73, pp 16-19) **Performance testing of the LUEhR-40M structure with an accelerated beam.** Vakhrushin, Yu.P.; Voznyuk, V.N.; Nikolaev, V.M.; Ryabtsov, A.V.; Smirnov, V.L.; Terent'ev, V.V. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

The results of experimental investigation of the prototype of the accelerating structure of the therapeutic linear accelerator of the LUEhR-40M model with an accelerating beam are presented. The accelerating structure is the standing wave biperiodic structure with inner coupling cells of 1.6 m length. The design energy of accelerated electrons equalling 20 MeV (during single electron beam passage through an accelerating structure) is obtained. 60 % of accelerated particles are accumulated in the energy interval of (20+-1) MeV at 20 mA pulse current and at 3.6 MW SHF-power at the structure input. 3 refs.; 3 figs.

22859 (INIS-SU—73, pp 36-38) **Study on casting niobium superconducting accelerating resonators.** Sokolov, B.A.; Smirnov, V.L.; Sorokin, E.K.; Komkov, A.A.; Maslennikov, O.L.; Fomin, A.L.; Tsygankova, T.A. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

Cavity E/sub 010/-resonators are the useful and convenient model when developing superconducting resonance structures of electron accelerators. The results of measurements of proper Q-factor and critical fields of superconducting E/sub 010/-resonators and 10-cm short diaphramatic wave guides are presented. It is shown that residual surface resistance of cast niobium of the NσR-type can be decreased almost to the theoretical value. Application of the same methods of treatment to niobium of the NVCh-type allows to form the surface, resistance of which is almost by an order higher. The surface state and niobium cavity purity are discussed. 8 refs.; 3 figs.

22860 **(IRE—345(1987)) Experimental investigation of diffraction of E-polarized surface wave at a ridge-grating.** Provalov, S.A.; Skrynnik, O.B. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki). 1987. 22p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706206/JAW.

A diffraction phenomenon of E-polarized inhomogeneous plane wave at a ridge grating is experimentally investigated. The source of such waves is a dielectric waveguide with the elliptical cross-section where a hybrid HE/sub 11/-wave is propagating. The comparison of experimental results and the values calculated is given and they proved to be in a good agreement. The results reported might be of use in the design of functional elements of transmission lines in the mm range; radiating systems, filters of surface waves. 6 refs.; 4 figs.

22861 (JAERI-M—88-149, pp 40-45) **Construction of 35 MeV DSM at Nihon University.** Hayakawa, K.; Sato, K.; Tanaka, T.; Takeda, O. (Nihon Univ., Tokyo (Japan). Atomic Energy Research Inst.). Aug 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780071/JAW. (CONF-8803200—).

From 1. workshop on the free electron laser; Tokai, Japan (1 Mar 1988).

High quality electron beam is needed for the excitation of the free electron laser(FEL). Construction of the 35 MeV double-sided microtron for the FEL has been started at 1984. This accelerator will feed a electron beam which has narrow energy width and low emittance. A first one turn beam line has been completed. Beam accelerating experiments and high power microwave tests are performed.

22862 (JAERI-M—88-149, pp 111-114) **Software tools for the particle accelerator designs.** Sugimoto, Masayoshi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Aug 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780071/JAW. (CONF-8803200—).

From 1. workshop on the free electron laser; Tokai, Japan (1 Mar 1988).

The software tools used for the designs of the particle accelerators are going to be implemented on the small computer systems, such as the personal computers or the work stations. These are called from the interactive environment like a window applica-

tion program. The environment contains the small expert system to make easy to select the design parameters.

22863 **(LA-UR—89-599) Superfish accuracy dependence on mesh size.** Merson, J.L.; Boicourt, G.P. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—4). NTIS, PC A02 - OSTI. Order Number DE89007992/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

The RF cavity code SUPERFISH is extensively used for the design of drift-tube linac (DTL), radio-frequency quadrupole (RFQ), and coupled-cavity linac (CCL) structures. It has been known for some time that considerably finer meshes are required near the nose of a drift tube to ensure accurate calculation of the resonant frequency and related secondary quantities. This paper discusses the results of numerical experiments designed to provide rules to set proper mesh sizes for DTL, RFQ, and CCL problems. During this work, SUPERFISH problems involving more than 100,000 mesh points were solved. 3 refs., 6 figs.

22864 **(LA-UR—89-906) The Los Alamos advanced hadron facility.** Garvey, G.T. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 11p. (CONF-890388—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009289/JAW.

From 4. European Physical Society seminar on international research facilities; Zagreb, Yugoslavia (17 Mar 1989).

A brief discussion of the plans for the Los Alamos Advanced Hadron Facility (AHF) will be presented. The plans include a 60-GeV proton main ring and two intense lower energy proton beams (1.6 GeV) for a pulsed-neutron source and low duty factor neutrino source. Brief remarks will be made about the physics program and funding status. 10 refs., 3 figs., 6 tabs.

22865 **(LAL—8819) Calibration of the DELPHI TPC to measure dE/dx. Study of beauty meson oscillation in DELPHI.** Antilogus, P. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire; Paris-7 Univ., 75 (France)). Jun 1988. 187p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88757355/JAW.

The TPC (Time Projection Chamber) of DELPHI which gives 16 tridimensional space-points for each charged track, is fundamental in the reconstruction of L.E.P. events with complex topology. This detector with its measurement of the energy lost by particles in the Ar/CH4 mixture, permits also separation between electron and pion at 3 standard deviations below 7.5 GeV. In this thesis we develop the control of systematic errors in the energy lost measurement. More precisely, we present results on the 12 TPC proportional chambers calibration. With these measurements we can use the identification power of the TPC in the best condition. In the second part of this thesis, we develop different methods on the beauty meson oscillation measurement. We estimate the possibility for the DELPHI detector in this sector. Particularly, we introduce the differential measurement of the oscillation which seems to be the only method to have access to the maximal mixing of the B/sub s//sup 0//antiB/sub s//sup 0/ mesons.

22866 **(LBL-PUB—496-No.5) Bevalac operations update: Pub. 496, No. 5.** (Lawrence Berkeley Lab., CA (USA)). Mar 1989. Contract AC03-76SF00098. 36p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009222/JAW.

This report contains information on the following experiments: Beam 30-1 (Dilepton Spectrometer); Beam 30-2 (Janus Spectrometer); Beam 39 I Low Energy Program; Beam 39 II Irradiation Station; Beam 39 III Irradiation Station; Beam 40 I RTE; Beam 40 II NASA; Beam 42 I EOS; Beam 42 II Radioactive Beams-Nuclear Radii; Beam 42 III Fragmentation; Beam 42 IV TPC; Beam 42 V Time of Flight Wall; Beam 44 I Low Energy Program; Beam 44 II Radioactive Beams-Magnetic Moments; Beam 44 III Antiprotons; AIP 86-Uranium Intensity; AIP 87-SHILAC Drift Tubes; AIP 88-Computer Control Upgrade I; AIP 89-Computer Control Upgrade II; AIP 90-External Particle Beam Lines Control; AIP 91-Power Supplies; BEVAX Developments; Spiller Control; and, New Pulsed Switching Magnet. 20 figs.

22867 **(SLAC-PUB—4859) Where do we stand on the SLC [SLAC Linear Collider]?.** Kozanecki, W. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1989. Contract AC03-76SF00515. 11p. (CONF-881073—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008944/JAW.

From Topical conference on physics in collision; Capri, Italy (19 Oct 1988).

This paper reviews the current performance of the SLAC Linear Collider, as well as the issues, problems and prospects facing the project. A few of the original accelerator physics results achieved in the last year are described in detail. 36 refs., 12 figs., 1 tab.

22868 **(TRI-PP—88-99) A kaon factory for TRIUMF.** Measday, D.F. (British Columbia Univ., Vancouver (Canada). Dept. of Physics). Nov 1988. 7p. (CONF-8808198—2). NTIS (US Sales Only), PC A02/MF A01 - OSTI. Order Number DE89007646/JAW.

From Excited baryons; Troy, NY, USA (4 Aug 1988).

The design study for the TRIUMF Kaon Factory has recently been funded. A short discussion of the scientific motivation is given first, followed by a brief description of the 30 GeV synchrotron which is being proposed. There will be five rings altogether using the present TRIUMF 500 MeV cyclotron as an injector. If the project is funded in 1990 the accelerators would be completed in 1995 or so, and the experimental programme would start a year later. 15 refs., 2 figs., 2 tabs.

22869 **(UCRL—100628) The Mirrortron ion linear accelerator concept.** Post, R.F. (Lawrence Livermore National Lab., CA (USA)). 14 Mar 1989. Contract W-7405-ENG-48. 14p. (CONF-890197—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009263/JAW.

From Advanced accelerator concepts workshop; Lake Arrowhead, CA, USA (9 Jan 1989).

A new type of ion linac, the Mirrortron, is described. It consists of a series of mirror cells within which high transient electric fields of space charge origin are generated, timed in synchronism with the arrival of a bunched ion beam. The space charge fields are generated by the sudden application of a localized pulsed mirror field within the cell. Accelerating fields up to two orders of magnitude higher than those in conventional ion linacs seem possible. The Mirrortron may be particularly suited for the acceleration of heavy-ion beams at high peak currents. Theoretical analyses and scaling laws are given. 7 refs., 2 figs.

22870 **Towards an advanced hadron facility at Los Alamos.** Thiessen, H.A. (Los Alamos National Laboratory, Los Alamos, NM 87548). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 277-289(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

In the 1987 AHF Workshop, it was pointed out that activation of the accelerator is a serious problem. At this workshop, it was suggested that a new type of slow extraction system is needed to reduce the activation. We report on the response to this need. The Los Alamos plan is reviewed including as elements the long lead-time R&D in preparation for a 1993 construction start, a menu of accelerator designs, improved losses at injection and extraction time, active participation in the development of PSR, an accelerated hardware R&D program, and close collaboration with TRIUMF. We review progress on magnets and power supplies, on ceramic vacuum chambers, and on ferrite-tuned rf systems. We report on the plan for a joint TRIUMF-Los Alamos main-ring cavity to be tested in PSR in 1989. The problem of beam losses is discussed in detail and a recommendation for a design procedure for the injection system is made. This recommendation includes taking account of single Coulomb scattering, a painting scheme for minimizing foil hits, and a collimator and dump system for containing the expected spills. The slow extraction problem is reviewed and progress on an improved design is discussed. The problem of designing the accelerators for minimum operation and maintenance cost is briefly discussed. The question of the specifications for an

advanced hadron facility is raised and it is suggested that the Los Alamos Proposal of a dual energy machine: 1.6 GeV and 60 GeV: is a better match to the needs of the science program than the single-energy proposals made elsewhere. It is suggested that design changes need be made in all of the world's hadron facility proposals to prepare for high-intensity operation.

22871 **Beam breakup in superconducting recirculating linacs.** Bisognano, J.J. (Continuous Electron Beam Accelerator Facility 12000 Jefferson Avenue, Newport News, Virginia 23606). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 309-314(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The performance and operational flexibility of superconducting recirculating linacs can be limited by a variety of collective phenomena which are grouped under the name beam breakup. In this note the various beam breakup phenomena found in recirculating superconducting radio frequency linacs are described and appraised relative to beam performance. (AIP)

22872 **Recent experience in accelerating polarized beam at the AGS.** Ratner, L.G. (Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1126-1131(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The most recent operation of the AGS for polarized protons occurred in December, 1987 and January, 1988. The primary purpose during this period was to tune up the accelerator as soon as possible and to provide a usable polarized beam for high energy physics. We succeeded in providing 1-2 x 10^{10} polarized protons per pulse at 18.5 GeV/c with an average polarization of 43 +- 3% and a peak of 52%. The conditions for this run differed in some respects from the previous run done in 1986. Due to problems with the main ring power supply, we were forced to use a back-up MG set which was only capable of 60% of the normal field rate of rise. This, of course, enhanced the effect of the depolarization resonances. A second difference was the fact that a complete horizontal and vertical realignment of the ring magnets was done during the 1987 summer shutdown. In addition, the fast pulsed quadrupole positions were readjusted with respect to the equilibrium orbit. It had been suspected that misalignment of these quads was responsible for large transverse emittance growth in both planes. We will look at the effects of these differences, but the bottom line is that the "standard correction techniques" worked as expected. (AIP)

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 22797, 22871, 22925, 22939, 22966

22873 **(ANL-HEP-CP—89-30) The development of plasma lenses for linear colliders.** Norem, J.; Cole, B.; Gai, W.; Mtingwa, S.; Rosenzweig, J.; Simpson, J.; Schoessow, P.; Cline, D.; Katsouleas, T.; Nantista, C.; Rajagopalan, S. (Argonne National Lab., IL (USA)). 1989. Contract W-31109-ENG-38. 3p. (CONF-890335—49). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009793/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

The plasma lens, first proposed by Chen, can in principle raise the luminosity of a linear collider with minimal interaction with the accelerator systems, nevertheless the short focal length lens design does interact strongly with the design of the particle detector at the interaction point. We have thus considered a of number options for using the lens and have begun to test plasma focusing experimentally. This paper briefly reviews constraints on use of the lens and its proposed operating modes, and then describes tests of a prototype valve/nozzle system and experimental tests of focusing. 10 refs., 3 figs.

22874 **(BNL—42331) Scattering of polarized photons at LEGS.** Sandorfi, A.M.; Blanpied, G.; Blecher, M.; Giordano, G.; Kistner, O.C.; Matone, G.; Preedom, B.M.; Schaerf, C.; Sealock, R.M.; Thorn, C.E. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 35p. (CONF-8807135—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008502/JAW.

From International school of intermediate energy nuclear physics; Venice, Italy (6 Jul 1988).

The Laser-Electron-Gamma-Source (LEGS) facility at Brookhaven National Laboratory is now coming into operation. This facility delivers intense, monochromatic beams of medium-energy gamma rays that are almost completely polarized (linear or circular), and this degree of freedom has altered the status of a number of important experiments from being impossible to now being merely difficult. In this lecture we will describe the key features of the LEGS facility, and discuss two elastic scattering experiments on the nucleon, one in the region of the first resonance which is sensitive to the E2/M1 mixing ratio in the delta, and the other below pion threshold which is sensitive to the nucleon polarizabilities. These will illustrate the unique potential of the polarization degree of freedom. 36 refs., 9 figs., 4 tabs.

22875 **(CONF-890335—53) A synchronous beam sweeper for heavy ions.** Bogaty, J.M. (Argonne National Lab., IL (USA)). 1989. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009772/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

The Argonne Tandem Linac Accelerator System (ATLAS) facility at Argonne National Laboratory provides a wide range of accelerated heavy ions from the periodic table. Frequently, the beam delivery rate of 12 MHz is too fast for the type of experiment on line. Reaction by-products from a target bombardment may have a decay interval much longer than the dead time between beam bunches. To prevent data from being corrupted by incoming ions a beam sweeper was developed which synchronously eliminates selected beam bunches to suit experimental needs. As the SWEEPER is broad band (DC to 6 MHz) beam delivery rates can be instantaneously changed. Ion beam bunches are selectively kicked out by an electrostatic dipole electrode pulsed to 2 kVDC. The system has been used for almost three years with several hundred hours of operating time logged to date. Beam bunch delivery rates of 6 MHz down to 25 kHz have been provided. Since this is a non-resonant system any beam delivery rate from 6 MHz down to zero can be set. In addition, burst modes have been used where beam is supplied in 12 MHz bursts and then shut down for a period of time set by the user. 3 figs.

22876 **(FNAL-TM—1556) Coupled transverse motion.** Teng, L.C. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1989. Contract AC02-76CH03000. 22p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009701/JAW.

The magnetic field in an accelerator or a storage ring is usually so designed that the horizontal (x) and the vertical (y) motions of an ion are uncoupled. However, because of imperfections in construction and alignment, some small coupling is unavoidable. In this lecture, we discuss in a general way what is known about the behaviors of coupled motions in two degrees-of-freedom. 11 refs., 6 figs.

22877 **(INIS-SU—73, pp 26-29) Calculation and tuning of an accelerating structure of linear resonance proton accelerator with low energy of injection.** Danilov, V.D.; Il'in, A.A.; Pronin, A.N.; Revkov, A.A.; Sobenin, N.P. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

The results of calculation and tuning of the accelerating structure of a linear resonance proton accelerator with alternation-

phase focusing, 30 keV injection energy, 500 keV output energy, and 0.4 capture coefficient are presented. A resonator with oncoming bars excited in the H/sub 3/-type oscillations at the 150 MHz frequency is chosen as the accelerating structure. Parameters of an accelerator flight channel are determined on the basis of nonlinear analytical relations obtained when analyzing proton dynamics stability in the field of a complex harmonic composition. Numerical simulation of beam dynamics in the chosen structure confirming the correstness of the calculation methods used is carried out. Peculiarities of tuning of an experimental model and restrictions to select the characteristics of the flight channel related to the possibility of tuning, are discussed. Account of these characteristics when calculating the accelerator permits to increase the efficiency of structure development. 6 refs.; 4 figs.

22878 (INIS-SU—73, pp 33-35) **On ion stability in intense pulsing electron beams.** Bulyak, E.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

The interaction of electrons with positive ions of a residual gas, which are confined by a beam space charge plays an important role in dynamics of electron intense beams. The method for determining the instability of ions in pulse intense beams of electrons based on a self-consistent laminar model is developed. Regions of ion stability in beams of a round and ribbon cross section are calculated. It is shown that linear density of ions in the beam does not exceed the linear density of the beam itself; the limiting density of the beam, above which the skeleton doesn't form, exists. 6 refs.; 1 fig.

22879 (INIS-SU—73, pp 42-44) **Simulation of transverse instability in a separate section of variable geometry.** Smirnov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

The results of numerical simulation of transverse instability in the first accelerating section of a new variant of the Fakel linear electron accelerator (LEA) operating under transient conditions are analysed on the basis of the solution of problems on excitation of the inhomogeneous structure mismatched on the ends near the boundary of the bandwidth. On the basis of critical beam parameters calculated, when current pulse discription in the modernized Fakel LEA variant, it is concluded that current limiting values caused by transverse instability exceed the corresponding values found from the calculations of longitudinal dynamics. 9 refs.; 2 figs.

22880 (INIS-SU—73, pp 64-69) **Charged particle acceleration in a plasma resonator.** Balakirev, V.A.; Bliokh, Yu.P.; Borodkin, A.V.; Onishchenko, I.N.; Ostrovskij, A.O.; Sotnikov, G.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

Charged particle acceleration by modulated fluxes in plasma and corrugated resonators of show oscillations are investigated. Inhomogeneity of a high-frequency field in a resonator cross section is used to create the conditions of effective acceleration. The relativistic flux of electrons is injected in the region, where the field is low, and accelerated particles - where it reaches the maximum value. The accelerated particles are placed in a resonance with the general field harmonic, and modulated flux with the first spatial field harmonic. 9 refs.; 5 figs.

22881 (INIS-SU—73, pp 70-72) **Analytical study on discrete model of virtual cathode in a high-current diode.** Privezentsev, A.P. 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

Interest in investigation of virtual cathode dynamics related to the development of high-current accelerator equipment is caused by the possibility of its application for ion collective acceleration in direct high-current electron beams and generation of power electromagnetic radiation. The Hamiltonian form of a plane sheet model for a high-current flux in a plane diode is investigated. Variables used permit to carry out the investigation of dynamics of the virtual cathode flux by the method of coordinate point transformations in a phase space. The necessity of numerical integration of sheet motion equations is dropped out in this case. Analytical solution of the suggested iterative circuit for total flux passage is presented as an example. The solution obtained is equivalent to the known results of the plane diode theory, obtained in the hydrodynamic approximation. 8 refs.

22882 (INS-T—483) **Physics of high current beams.** Lawson, J.D. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). May 1988. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757233/JAW.

An outline is presented of paraxial charged particle optics in the presence of self-fields arising from the space-charge and current carried by the beam. Solutions of the envelope equations for beams with finite emittance are considered for a number of specific situations, with the approximation that the density profile of the beam is uniform with a sharp edge, so that the focusing remains linear. More realistic beams are then considered, and the problems of matching, emittance growth and stability are discussed. An attempt is made to emphasize physical principles and physical ideas rather than to present the detailed mathematical techniques required for specific problems. The approach is a tutorial one, and several 'exercises' are included in the text. Most of the material is treated in more depth in the author's forthcoming book.

22883 (INS-T—484) **Physics of particle acceleration and the search for new ideas.** Lawson, J.D. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jun 1988. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757234/JAW.

In recent years there has been an intensive search for 'new ideas' to enable the energy range of accelerators to be increased beyond that attainable with existing techniques. Some comment is made on these ideas, but before this is done, a general discussion of accelerating mechanisms is presented.

22884 (IRE—346(1987)) **Electron flow in stationary magnetic field with periodic inhomogeneities.** Shtan'ko, A.A. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki). 1987. 35p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706207/JAW.

Focusing of axially-symmetric and strip electron flows by a stationary magnetic field with periodic inhomogeneities of the sinusoidal type has been considered. An equation of the boundary paraaxial electron in such fields has been obtained and the solution of an non-linear equation by linear approximation has been carried out, but for axially-symmetrical beam by a numerical method. On the basis of calculation data possibilities of electron transportation with small pulsations depending on the relation of amplitudes of stationary and periodic magnetic fields are investigated. The results of experimental investigations are given. 9 refs.; 1 fig.

22885 (ITEF—10(1988)) **Coulomb structural resonances in high-current channels.** Zenkevich, P.R.; Korolev, A.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706210/JAW.

A seft-congruent potential for an ion beam with an uniform distribution in the phase space is calculated in the mooth approximation. This potential is used to calculate the Coulomb force for structural resonances of the third, fouth and fifth orders in high-

current transport channels. The effect of these resonances on the high-intense particle beam dynamics is considered. The estimates of autophasing range width and the growth of oscillation amplitude square in the case of resonance crossing are obtained. 9 refs.; 7 figs.

22886 (JAERI-M—88-149, pp 29-34) **Application of linear accelerators of ISIR, Osaka University of FEL study.** Tsumori, K.; Hori, T.; Okuda, S.; Takeda, S. (Osaka Univ., Ibaraki (Japan). Inst. of Scientific and Industrial Research). Aug 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780071/JAW. (CONF-8803200—).

From 1. workshop on the free electron laser; Tokai, Japan (1 Mar 1988).

When RF linear accelerators are developed as components of free electron laser(FEL) systems, the main problem is in achieving extremely high beam quality. We have been studying the characteristics of the electron single bunches from a 35-MeV L-band linear accelerator of ISIR, Osaka University. Beam emittance of a 145-MeV S-band linear accelerator which is under construction is being investigated. Basic research for gas loaded FEL has been made by using beams from the 35-MeV accelerator. In this report the results of the experiments and the future plans of FEL research performed with the two linear accelerators are outlined.

22887 (JAERI-M—88-149, pp 53-56) **RF linac FEL study at NERL of the University of Tokyo.** Ohashi, Hirotada; Hazima, Ryoichi; Kishimoto, Maki; Kobayashi, Hitoshi; Kondou, Syunsuke. (Tokyo Univ., Tokai, Ibaraki (Japan). Nuclear Engineering Research Lab.). Aug 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780071/JAW. (CONF-8803200—).

From 1. workshop on the free electron laser; Tokai, Japan (1 Mar 1988).

22888 (JAERI-M—88-149, pp 60-66) **Design considerations of the JAERI superconducting linac for free electron laser.** Ohkubo, Makio. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Aug 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780071/JAW. (CONF-8803200—).

From 1. workshop on the free electron laser; Tokai, Japan (1 Mar 1988).

Preliminary design considerations are made on an FEL system including a superconducting linac. The system is designed to produce infra-red light with an average power of 300 W, using a 25 MeV CW electron beam of average power 25 kW. The optical system, the one-pass gain, the rise time, the injection system, the accelerating structures and the CW klystrone are discussed.

22889 (JAERI-M—88-149, pp 92-95) **Measurements of permanent magnet pieces and PMQ lens.** Okamoto, H.; Sawamura, M. (Kyoto Univ., Uji (Japan). Inst. for Chemical Research). Aug 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780071/JAW. (CONF-8803200—).

From 1. workshop on the free electron laser; Tokai, Japan (1 Mar 1988).

Magnetized directions of permanent magnet pieces named NEOMAX-30H and HS-30CH, which consist of neodymium, iron and boron, were measured. NEOMAX-30H is made by Sumitomo Special Metals Co., Ltd. and HS-30CH by Hitachi Metals Co., Ltd. Averaged difference between disigned and real magnetized direction was about 1 deg. Using these pieces, permanent magnet quadrupole(PMQ) lens were fabricated and the harmonic fields in the aperture were measured.

22890 (JINR—R-11-88-15) **Computerized simulation of spatial distribution of boundary field of synchrotron dipole magnet.** Zhidkov, E.P.; Mazurkevich, G.E.; Khoromskij, B.N.; Yudin, I.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1988. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706257/JAW.

Submitted to the journal Zh. Tekh. Fiz.

To study spatial distribution of boundary field of SPIN synchrotron dipole magnet a technique for calculation of three-dimensional nonlinear open magnetic systems is used. This technique is based on application of the potential theory boundary integral equations determined on auxiliary region surface for precise account of magnetic field behaviour in infinity. The boundary problems arising in the auxiliary region containing the initial magnetic system are solved by grid methods. The calculations were carried out using MOK 31 complex program. The results of simulation, comparison with the experimental data are presented. 22 refs.; 6 figs.; 3 tabs.

22891 (LA-UR—89-767) **A lattice with no transition and large dynamic aperture.** Guignard, G. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—15). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009405/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

In the case of a one-ring high-energy scheme for an advanced hadron facility, beam losses can be reduced if the ring lattice accomodates the beam from injection to maximum energy without crossing the transition. Since there is no synchrotron booster in such a scheme and the injection energy is relatively low, this requirement implies a negative compaction factor and an imaginary transition energy. This can be achieved by making the horizontal dispersion negative in some regions of the arcs so that the average value taken in the dipoles is globally also negative. Such a modulation of the dispersion may result in an increasing difficulty to obtain a large enough dynamic aperture in the presence of sextupoles. A careful optimization is therefore necessary and the possibility of modifying the linear lattice in order to include the requirements associated with chromaticity adjustments has to be studied. This paper summarizes the work done along this line and based on previous searches for a race track lattice that can be used in a hadron facility main ring. It describes an alternative lattice design, which tends to minimize the effects of the nonlinear aberrations introduced by sextupoles and to achieve a large dynamic aperture, keeping the betatron amplitudes as low as possible. 7 refs., 6 figs., 1 tab.

22892 (LA-UR—89-808) **Robinson instability and longitudinal mode coupling.** Wang, Tai-Sen F. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—14). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009401/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

Robinson's stability conditions are rederived by using Sacherer's integral equation. The relation between the maximum stable beam current and the cavity detuning is reproduced with a correction to account for the equilibrium phase-space distribution of beam particles. The coupling between the longitudinal dipole and quadrupole modes is also studied. It is found that the coupling modifies Robinson's stability conditions significantly in the small cavity detuning region. 6 refs., 5 figs.

22893 (LA-UR—89-887) **Simulation of an RFQ [radio-frequency quadruple] funnel for heavy-ion beams.** Guy, F.W.; Stokes, R.H. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—40). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009385/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

Use of the magnetic force to focus and deflect heavy-ion beams is marginal at low ion velocities. Low-emittance-growth funnels using discrete magnetic elements are difficult to design for these beams. We show that a new type of radio-frequency quadruple (RFQ) funnel is especially suitable for this application. Simulation procedures, which include space-charge and image effects, have produced a high-quality funnel design for 20-MeV Bi^{+1} ions. 4 refs., 4 figs., 2 tabs.

22894 **(LA-UR—89-944) Generating catalogs of transverse matching solutions.** Swain, G.; Busch, P.; Burns, M. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—34). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009278/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

Programs such as TRANSPORT or TRACE can find transverse beam matching solutions one at a time when given appropriate starting conditions. In the present work, an algorithm is described which rapidly finds a catalog of approximate transverse beam matching solutions. For a given initial beam, the algorithm finds the gradients of four quadrupole magnets such as to get four Twiss parameters (alpha and beta for horizontal and vertical planes) which are close to a set of desired values at the exit of a constant-energy beam line with no horizontal-vertical cross coupling and no space charge. The beam line may contain bending elements with edge corrections and other elements for which the r matrixes are known. The algorithm transforms the entrance and exit beam specifications to waist specifications, and uses the properties of waist-to-waist transport to reduce the problem from a four dimensional search to a two dimensional search. At the Los Alamos Meson Physics Facility (LAMPF) accelerator, transverse matching is important in the low-energy transport lines (0.75 MeV), where beams from the H^+, H/sup {minus}/, and polarized H/sup {minus}/ sources must be tailored for injection into the drift-tube linac; and in the transition region (100 MeV), where the beam from the drift-tube linac is injected into the side-coupled linac. Space charge has significant effects in the low-energy transport, but it is still valuable to get no-space-charge matching solutions as a starting point for solutions with space charge. 2 refs.

22895 **(LA-UR—89-949) Scaling relations for a beam-deflecting TM_{110} mode in an asymmetric cavity.** Takeda, H. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—33). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009277/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

A deflecting mode in an rf cavity caused by an aperture of the coupling hole from a waveguide is studied. If the coupling hole was a finite size, the rf modes in the cavity can be distorted. We consider the distorted mode as a sum of the accelerating mode, and the deflecting mode. The finite-size coupling hole can be considered as radiating dipole sources in a closed cavity. Following the prescription given by H. Bethe, the relative strength of the deflecting mode TM_{110} to the accelerating TM_{010} mode is calculated by decomposing the dipole source field into cavity eigenmodes. Scaling relations are obtained as a function of the coupling hole radius. 2 refs., 6 figs.

22896 **(LA-UR—89-950) Comparison of energy spreads induced by a wakefield in a cavity.** Takeda, H.; Chan, K.C.D.; Thode, L.E. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—32). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009276/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

The energy spread of a beam bunch induced in a linear accelerator can be reduced to a minimum if the amplitude and the phase of the RF voltage are optimized. The energy spread is induced by the longitudinal wakefield and by the sinusoidal profile of the accelerating voltage acting on the beam. The cavity shape, the bunch profile, and the charge in the bunch determine the wake function. Aiming to have an approximately constant net voltage acting across the beam bunch, we optimize the amplitude and the phase of the RF voltage. The minimum energy spread, the required RF voltage, and the required RF phase are calculated as a function of the net charge and the length of the bunch. To find out the effect of cavity shape on the minimum energy spread, the optimization was performed for several types of cavities. 4 refs., 8 figs.

22897 **(LBL—25759-Rev.) Plasma suppression of beamstrahlung: Revision.** Whittum, D.H.; Sessler, A.M.; Stewart, J.J.; Yu, S.S. (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098;W-7405-ENG-48. 33p. (CONF-880755—1-Rev.). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008153/JAW.

From Conference on submicron particle beam dynamics and plasma acceleration methods; Santa Barbara, CA, USA (18 Jul 1988).

We investigate the use of a plasma at the interaction point of two colliding beams to suppress beamstrahlung and related phenomena. We derive conditions for good current cancellation via plasma return currents and report on numerical simulations conducted to confirm our analytic results. 17 refs., 5 figs., 5 tabs.

22898 **(SLAC-PUB—4776) Operational experience with optical matching in the SLC Final Focus System.** Bambade, P.; Burchat, P.; Burke, D.; Ford, W.; Hawkes, C.; Koska, W.; Kozanecki, W.; Lohse, T.; Mattison, T.; Phinney, N. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1989. Contract AC03-76SF00515. 7p. (CONF-890335—11). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008641/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

In the SLC Final Focus System, all components of transverse phase-space and the couplings between them must be controlled to minimize the beam size at the interaction point. After summarizing the experimental algorithm and the on-line tuning programs, we present a consistent set of measurements and describe our present understanding of the various contributions to this beam size. 17 refs., 9 figs.

22899 **Radial focusing in a linear induction accelerator gap.** Chen, Y.; Reiser, M. (Laboratory for Plasma Research, University of Maryland, College Park, Maryland 20742). *Journal of Applied Physics;* **65**: No. 9, 3324-3328(1 May 1989).

The focusing properties of the electric field distribution in a linear induction accelerator gap are identical to those of a bipotential electrostatic lens if the particle gap-transit time is small compared with the time variation of the induced electric field. Bipotential lenses have been studied systematically only in the nonrelativistic case. In this paper we present the results of a theoretical study of the focusing properties of a symmetrical two-cylinder lens with identical radii and negligible separation for relativistic electron beams. Analytical formulas derived by using the thin-lens approximation are compared with the results of numerical integration of the relativistic paraxial ray equation and found to be sufficiently accurate for practical applications.

22900 **Beam optics of a self-focusing plasma lens.** Rosenzweig, J.B.; Chen, P. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 7, 2039-2045(1 Apr 1989).

In this paper we analyze the optics of a high-energy beam which is focused by its own wakefields in a plasma. We calculate the effects of lens aberrations on the focusing strength of the lens and on the dilution of the beam's phase space. From this we derive the minimum spot size achievable using a bi-Gaussian beam and, after inclusion of the beam-beam pinch effect, the luminosity enhancement that can be gained in principle. We estimate the luminosity enhancement in the case of SLAC Linear Collider beam design parameters, and discuss limitations and possible improvements in plasma-lens performance.

22901 **Spin dynamics in accelerators and storage rings.** Teng, L.C. (Fermi National Accelerator Laboratory, Batavia, IL 60510). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 208-225(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The understanding of charged particle orbital dynamics in an electromagnetic field is necessary for the acceleration and the storage of particles. The understanding of spin (or magnetic moment) dynamics is essential for the acceleration and the storage of polarized particle beams. In this paper we review the analysis of the dynamics of the spin and the various schemes and devices up-to-date to manipulate the spin to conserve the polarization while accelerating and storing a polarized beam. We shall concentrate on hadrons such as protons, antiprotons and heavier ions although most of the discussions apply equally well to leptons. Electron and positron beams are self-polarizing through spin-flip synchrotron radiation at high energies and hence the acceleration of polarized e/sup +- / beams is less relevant. (AIP)

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 22866, 22873, 22893, 22895

22902 **(BNL—41979) Measurement of internal forces in superconducting accelerator magnets with strain gauge transducers.** Goodzeit, C.L.; Anerella, M.D.; Ganetis, G.L. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 7p. (CONF-880812—43). NTIS, PC A02 - OSTI. Order Number DE89008158/JAW.

From Applied superconductivity conference; San Francisco, CA, USA (21 Aug 1988).

An improved method has been developed for the measurement of internal forces in superconducting accelerator magnets, in particular the compressive stresses in coils and the end restraint forces on the coils. The transducers have been designed to provide improved sensitivity to purely mechanical strain by using bending mode deflections for sensing the applied loads. Strain gauge resistance measurements are made with a new system that eliminates sources of errors due to spurious resistance changes in interconnecting wiring and solder joints. The design of the transducers and their measurement system is presented along with a discussion of the method of compensation for thermal and magnetic effects, methods of calibration with typical calibration data, and measured effect in actual magnets of the thermal stress changes from cooldown and the Lorentz forces during magnet excitation. 13 figs., 1 tab.

22903 **(BNL—42085) High current polarized proton sources.** Alessi, J.G. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 18p. (CONF-881049—73). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008164/JAW.

From Linear accelerator conference; Williamsburg, VA, USA (3 Oct 1988).

Polarized proton sources are now being used more frequently on linacs. In pulsed operation up to 10 mA of {rvec H}$^+$ and 0.4 mA of {rvec H}/sup {minus}/ have been produced. The present status of these sources, and developments to reach even higher intensities, are reviewed. 39 refs., 1 tab.

22904 **(CONF-890335—27) Recent advancements in sputter-type heavy negative ion sources.** Alton, G.D. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008916/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

Significant advancement have been made in sputter-type negative ion sources which utilize direct surface ionization, or a plasma to form the positive ion beam used to effect sputtering of samples containing the material of interest. Typically, such sources can be used to generate usable beam intensities of a few μA to several mA from all chemically active elements, depending on the particular source and the electron affinity of the element in question. The presentation will include an introduction to the fundamental processes underlying negative ion formation by sputtering from a low work function surface and several sources will be described which reflect the progress made in this technology. 21 refs., 9 figs., 1 tab.

22905 **(DOE/ER/40048—217-L8) The Model 860i: A turbo sputter source.** Trainor, T.A. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1988. Contract AC06-81ER40048. 7p. (CONF-8810242—7). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008210/JAW.

From Symposium of Northeastern Accelerator Personnel; New Haven, CT, USA (24 Oct 1988).

The UW Model 860 is now fully commissioned and delivers intense beams of a variety of negative ions. Mass-analyzed beams include 400 μA ^{12}C/sup {minus}/, 50 μA ^{28}Si/sup {minus}/, 10 μA ^{7}Li/sup {minus}/, 100 μA ^{63}Cu/sup {minus}/, and 5 μA ^{40}Ca/sup {minus}/. These currents were observed through an acceptance of about 5 mrad-cm at 30 KeV, corresponding to an emittance of 8 mm-mrad-MeV/sup 1/2/. 6 figs., 1 tab.

22906 **(DOE/ER/40048—218-L8) Charging belt noise in a Van de Graaff accelerator.** Trainor, T.A. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1988. Contract AC06-81ER40048. 14p. (CONF-8810242—8). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008211/JAW.

From Symposium of Northeastern Accelerator Personnel; New Haven, CT, USA (24 Oct 1988).

With the aid of a Fast Fourier Transformer (FFT) spectrum analyzer it has been possible to decompose Van de Graaff terminal voltage noise into components that can be related to various properties of the charging belt. One consequence has been the elimination of the fundamental belt frequency component by a novel belt charge transfer device. 18 figs.

22907 **(DOE/ER/40048—219-L8) A foil stripper and terminal steering assembly for an FN tandem.** Weitkamp, W.G. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1988. Contract AC06-81ER40048. 4p. (CONF-8810242—9). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008209/JAW.

From Symposium of Northeastern Accelerator Personnel; New Haven, CT, USA (24 Oct 1988).

We recently installed a new foil stripper mechanism and steerer assembly in our FN tandem terminal. The project had the following goals: To significantly increase the number of foils in the tandem. We formerly had only a 38 foil capacity. Now that the new superconducting booster is running, demand for foils has increased drastically. To add horizontal steering plates to the vertical steering plates in the terminal. With conventional HVEC inclined field beam tubes, the position of the beam at the exit of the tandem is sensitive to the variation in value of the column resistors. Minor beam tube misalignments can also cause the beam to come out displaced horizontally by an annoying amount. To retain the gas stripper tube. We occasionally find it convenient to use gas stripping for low energy heavy ion beams and for ions for which the foil consumption rate is excessive. To electrically insulate all terminal components so the terminal ripple remover will continue to operate. The terminal ripple remover, which is designed to reduce beam energy fluctuations, places a rapidly varying 2-9 kV bias on the stripper foil or stripper gas canal in response to an energy correction signal derived from the image slits. The energy correction signal is transmitted optically to the terminal. 1 ref., 2 figs.

22908 **(FNAL-TM—1564) The A0 abort system for the Tevatron upgrade.** Crawford, C. (Fermi National Accelerator Lab., Batavia, IL (USA)). 1 Mar 1989. Contract AC02-76CH03000. 32p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009705/JAW.

The installation of electrostatic separator modules at B48 and C17 in the Tevatron necessitates changes to the Tevatron abort system. There will no longer be room for either the proton or antiproton kicker magnets used in the present system. The kickers at C17 will be permanently removed. The kickers at B48 will be temporarily removed for collider operation and will be replaced for fixed target operation. The existing proton abort system will remain unchanged during fixed target operation. This note describes a proposed abort system for operation in the collider mode for 22 on 22 bunches and provides details of specifications for the required components. In certain cases, for example in the case of the pulsers for

the magnets and the absorber assembly, system components are designed with the option of upgrading to 44 on 44 bunch operation in mind. 8 refs., 14 figs.

22909 **(FNAL-TM—1567) The new experimental areas oxygen monitor.** Schoo, D. (Fermi National Accelerator Lab., Batavia, IL (USA)). Aug 1988. Contract AC02-76CH03000. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009700/JAW.

Because of the nature of the beamline requirements for oxygen monitoring equipment to operate ancillary equipment, such as exhaust fans, doors and cryogenic valves, and because of the well known problems of the oxygen sensors installed in high radiation areas, a new design for sensing the oxygen content of ambient air was needed. A new monitor system was designed to solve these problems and some others that compromised the reliability and the maintenance of the monitoring system. From the operating experience gained with the Accelerator Standard Oxygen Monitor System currently installed in many locations in the experimental area, from suggestions solicited from the Safety Group and from the Cryogenics Group, I designed a new Experimental Areas Standard Oxygen Monitor. Many suggestions were carefully considered and a design that incorporates most of them was constructed. I will summarize a list of the important improvements that will be of interest to the users of the system, and explain how these functions will make the oxygen system easier to live with. 2 figs.

22910 **(IFVE-OEA—88-106) Monitoring system of extracted proton beams of the IHEP accelerator.** Gotsev, V.V.; Gres', V.N.; Davydenko, Yu.P. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706163/JAW.

The hardware and software realization for point beam monitoring system consisting of six subsystems are described. Six automated subsystems of beam monitoring are located in three-frames Vector-SUMMA with the self-sufficient frame AKK-83M controllers which include microcomputers based on microprocessor set of 5 K80 series. The monitoring system is succesfully operated for many years and has greatly contributed to the increase of intensities of beams extracted to experimental devices. 12 refs.; 2 figs.

22911 **(IFVE-OKU—88-9) Use of thin internal targets in the IHEP proton synchrotron.** Ado, Yu.M.; Aseev, A.A.; Kardash, A.A.; Kurov, A.P.; Sokolov, S.V.; Chernetsov, M.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706167/JAW.

A new internal target consisting of a carbon cloth ~50 mg/cm/sup 2/ thick for secondary particle generation has been applied at the IHEP accelerator. As a result the secondary beam time structure has considerably been improved even at the partially filled accelerator orbit (at injection from the booster or because of the FE). Besides, the thin target effectively supresses 200 kHz structure without any other masures for beam debunching. The data of the thermal calculations and experimental results for the thin targets are presented. 11 refs.; 7 figs.; 2 tabs.

22912 **(IFVE-OKU—88-96) System for synchronization of physical devices with the magnetic field at the IHEP accelerator.** Glukhov, Yu.S.; Kolupaev, B.A.; Pominov, P.N.; Pchelkina, E.I.; Lebedev, O.P. (AN SSSR, Moscow. Radiotekhnicheskij Inst.; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706168/JAW.

A structural description of the analogue-to-digital system synchronized with the magnetic field of the IHEP accelerator is given. It allows to operation with a 0.1Gz step within the field range from 330 to 12100 Gz. The working principles of the system and its modules are briefly described. The exprimental check-up of the beam synchronization system work has revealed its high reliability and accuracy. The stability of pulse synchronization to the magnetic field is +-1.2x10/sup -4/. 3 refs.; 4 figs.

22913 **(IFVE-OUNK—88-10) Longitudinal impedance of cyclic accelerator vacuum chamber with small cross-section variations. Calculational method.** Kurennoj, S.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706170/JAW.

Submitted to the journal Zh. Tekh. Fiz.

Calculational method of the longitudinal coupling impedance of the perturbations sequence, which are small variations of radius in the accelerator cylindrical vacuum chamber is developed. The method is based on the procedure of an expansion over small parameter in the boundary conditions/4,5/. The general expression for the impedance and characteristic features of resonances are obtained in the case when perturbations are disposed periodically. The dependence of the impedance on random violations of periodicity in perturbation disposition is investigated in the framework of statistical approach. 9 refs.; 2 figs.

22914 (INIS-SU—73, pp 3-7) **Accelerating sections with quasipermanent gradient for a 2 GeV electron linac.** Biller, E.Z.; Vishnyakov, V.A.; Dovbnya, A.N. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

The increase of the acceleration rate in electron linac structures is reviewed. New accelerating sections are developed to increase the electron linac beam energy up to the 2 GeV energy. Considerations concerning the choice of the structure, the results of calculations and tests with the beam of the accelerating sections made are presented. The average acceleration rate in the section of 4.3 m length more than 20 MeV/m is reached. 6 refs.; 5 figs.; 2 tabs.

22915 (INIS-SU—73, pp 8-10) **Study on cm-range power pulse gyrocon.** Balakin, V.E.; Brezhnev, O.N.; Zakhvatkin, M.N.; Kazakov, S.Yu.; Kozhemyakin, A.V.; Klyuev, V.F.; Solyak, N.A.; Yasnov, G.I. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

The structure and operation of the SHF 5 cm- range power amplifier prototype - the multiresonance gyrocon, are described. The EhLIT-L2 accelerator serves as the beam source for the prototype. The results of numerical simulation of beam optics in the gyrocon channel and the calculations of the amplification factor and the device efficiency are presented. Pulse power 60 MW with pulse duration 0.7 μs, the amplification factor of 65 dB are obtained in experiments with the given device. The power is absorbed in the load and it is measured by the M3-47 calorimeter. The 25% gyrocon efficiency reached in limited by the electric strength of an output resonator. The gyrocon is aimed at the excitation of the linear collider accelerating structure. 3 refs.; 4 figs.

22916 (INIS-SU—73, pp 11-13) **Short intense electron bunch shaping for supercolliders.** Karliner, M.M.; Koop, I.A.; Makarov, I.G.; Nezhevenko, O.A.; Yakovlev, V.P. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

Short intense electron bunch shaping for further acceleration in a linear collider is carried out by means of a special buncher providing the compression of initial bunches with the longitudinal size

of 8 cm till 0.5 cm. Bunches, containing 10 /sup 12/ particles, are injected with the 700 MeV energy from storage ring. The 430 MHz linear modulating standing wave HF-structure is the basis of the buncher. Designs providing the compensation of radiation fields effect and nonlinearity of the modulating HF-field are found. 6 refs.; 2 figs.

22917 (INIS-SU—73, pp 14-15) **Focusing channel for the 10 MeV proton accelerator.** Vengrov, R.M.; Kapchinskij, I.M.; Kujbida, R.P. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

The focusing channel for the 10 MeV proton linear accelerator is described. The channel comprises 33 drift tubes, each tube contains one quadrupole lens, and input and output semitubes with hemilenses. Quadrupole lenses consist of three series of cylindric permanent magnets. Peculiarities of the quadrupole structure and their magnetic characteristics are marked. 5 refs.; 2 figs.

22918 (INIS-SU—73, pp 20-23) **On choise electrode shape in a linear accelerator with spatial-uniform quadrupole focusing.** Balabin, A.I.; Lipkin, I.M.; Ugarov, S.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

The modulated four-wire circuit with quadrupolar symmetry of electric potential is used to shape accelerating-focusing fields in a linear accelerator with spatial-uniform quadrupolar focusing. Comparative analysis of accelerating-focusing field shaped by electrodes of different configuration is carrier out. Electrodes of a constant radius (semicircular electrodes with trapezoidal modulation), which, in comparison with the known electrodes of this type, provide higher rate of acceleration, and bing easier to manufacture, are suggested. 6 refs.; 5 figs.

22919 (INIS-SU—73, pp 24-25) **Magnetic measurements of quadrupole lenses for the 10 MeV proton accelerator.** Antipin, S.V.; Artemov, A.V.; Evlent'ev, V.M. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

To carry out measurements of the set of quadrpole lenses for the 10 MeV accelerator focusing channel, the on-line system containing a precision three-coordinate mechanism for Hall converter motion is created. General control of the system, measurement primary data acquisition and accumulation are carried out by a microcomputer. Methods for measuring the permanent magnet quadrupole lense magnetic field are described. Basic results of bank data processing are presented. 1 ref.; 1 fig.

22920 (INIS-SU—73, pp 30-32) **Experimental study of automodulation regimes in a driving selfoscillator of a linear electron accelerator and application of these regimes for generation of current pulses modulated at several frequency.** Ajzatskij, N.I.; Volobuev, V.V.; Ivanov, G.M. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

The results of experimental study of automodulation regimes in a selfoscillator based on a power klystron amplifier are described. It is shown that such regimes can be used in a linear electron accelerator to generate accelerated electron beams modulated not only at accelerator working frequency, but at lower ones. 8 refs.; 3 figs.

22921 (INIS-SU—73, pp 39-41) **Effect of thin metal coating on geometric resonances on reflection of electromagnetic wave from metallized dielectric sphere in a waveguide.** Popov, V.A.; Cherkasova, K.P.; Kukhtin, M.P.; Khizhnyak, N.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

Resonance reflection of the H/sub 10/-type electromagnetic wave in a rectangular wavequide from a dielectric ball covered with a thin layer of a metal is studied. The value of the reflection coefficient of the electromagnetic wave from a thin metallic layer is determined by the product of layer conductivity and its thickness, and the possition of resonances is shifted in relation to resonances of reflection from the ball without coating. Theory conclusions are confermed by experimental data. 9 refs.; 2 figs.

22922 (INIS-SU—73, pp 45-46) **Finite-size resonance dielectric cylinder in a rectangular waveguide.** Chuprina, V.N.; Khizhnyak, N.A. (Khar'kovskij Inst. Radioehlektroniki (Ukrainian SSR); AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

The problem on resonance spread of an electromagnetic wave by a dielectric circular cylinder of finite size in a rectangular waveguide is solved by a numerical-analytical method. The cylinder axes are parallel. The cylinder can be used as a resonance tuning element in accelerating SHF-sections. Problems on cutting off linear algebraic equation systems, to which relations of macroscopic electrodynamics in the integral differential form written for the concrete problem considered here are reduced by analytical transformations, are investigated in the stage of numerical analysis. Theoretical dependences of the insertion of the voltage standing wave coefficient on the generator wave length calculated for different values of problem parameters are constracted. 2 refs.; 2 figs.

22923 (INIS-SU—73, pp 49-50) **Acoustic probing of breakdowns in a diaphragmatic waveguide of an electron linac.** Dovbnya, A.N.; Zhiglo, V.F. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

The estimation of accuracy of acoustic probing in a diaphragmatic wavequide is obtained on the basis of experimental investigation of acoustic signal passage in the walls of the diaphragmatic wavequide of electron linac and this signal distortion by different types of acoustic receiver. The results of practical application of the method of acoustic probing of breakdowns at the 2 GeV LUEh accelerator are described. The highest accuracy of acoustic probing is obtained by means of the receiver, ovhere at transformer oil is used as a immersion liquid. 4 refs.; 1 fig.

22924 (INIS-SU—73, pp 57-60) **Technique for calculating the circuit for shaping the given accelerating voltage pulse in linear induction accelerators.** Demskij, M.I.; Kazankin, Yu.A.; Miroshnichenko, A.L. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

Duration of the flat-top region of the accelerating voltage pulse of a linear induction accelerator determines duration of beam current at the accelerator output. Methods of iterative synthesis of circuits for pulse shaping of the given form, permitting to reduce considerably the tuning time, are described. The methods are illustrated by shaping voltage pulse at the LUEh-1, 25-200 accelerator injector. The structure is determined and calculational formulae of circuit parameters are given. Spurious parameters of the circuit for shaping are taken into account in the physical model and when calculating transients using a computer. The three-dimensional characteristic of a ferromagnetic core is used when calculating. As calculations have shown, synthesis converges after 2-3 iterations. A double-link variant of the circuit for voltage pulse shaping in the cathode of an electron source is realized. Diagrams for voltage pulses at the injector, its physical model and a diagram of a pulse calculation shape are presented. The results obtained coincide well and testify to the correctness of synthesis problem solving. 4 refs.; 4 figs.

22925 (INIS-SU—73, pp 47-48) **Study on the transversal beam dynamics in an ion linac by physical simulation.** Dmitriev, B.S.; Zharkov, Yu.D.; Zhigulin, V.V.; Rozhkov, S.V.; Taran, S.A.; Shlepkin, V.N. (Saratovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Mekhaniki i Fiziki). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

Physical simulation based on the substitution of the ion beam by the electron one and on the application of an electron probe, in which the electron beam is separated from the HF-structure by an extended transparent for HF-fields vacuum-deuse shell, is the effective method of investigation of longitudinal dynamics of ion beams in a linac. The electron probe with an analyzer of beam current density distribution in the transverse cross section at the output of an accelerating structure is constructed to extend functional possibilities of the method. Current density distribution in the proton linac model with the accelerating structure in oncoming vibrators under static (without HF-power supply) and dynamic modes is investigated using it. 4 refs.; 2 figs.

22926 (INIS-SU—73, pp 51-54) **Pulse supersonic target for monitoring charged particle beams.** Demchenko, P.A.; Koval'chuk, I.K.; Maslov, N.N.; Shulika, N.G. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1988. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(36).

In Physical experiment engineering. Scientific-technical collection.

The necessity to develope the methods of nondestructive test of main parameters of such beams occurs in respect with the development of high-current ion accelerators with high power density in beams, in particular for thermonuclear fusion initiated by beams, and meson factories. Equipment to produce pulse supersonic gas targets with densities up to 5x10/sup 15/ cm/sup -3/, duration 1 ms and the Mach number 4-5 for optical tomography of high-current ion beams as well as detection methods of radiation excited by beams in a target are described. The equipment design to obtain pulse supersonic gas jets in vacuum includes: the Laval supersonic nozzle for gas-dynamic acceleration of gas and the pulse solenoid valve measuring the quantity of gas carried to the nozzle. The nozzle of 40 mm length and 0.5 and 6 mm in diameter of constriction and cut correspondingly is made of an aluminium alloy. The pulse solenoid valve consists of a solenoid, a ferromagnetic striker with seal and an opposing spring. 8 refs.; 4 figs.

22927 (INIS-SU—75, pp 15-24) **Study on polimer films and metal foils during thermal radiation effect of extracted proton beams.** Gurov, M.M.; Solov'ev, V.N. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780081/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Construction and building. Scientific-technical collection.

Results of calculation and measurement of the temperatures of metal foil and polymer film radiation heating under various heat transfer conditions for cyclic accelerator operation mode are prsented. Evaluations of thermoradiation stability of these materials are made based on the results obtained for the intensity of extracted proton beams of up to 3x10/sup 13/ protons/cycle. Methods are presented and results of forecasting the strength and durability of polyamide films and their compositions with fiber glasses are given for possible operational conditions for materials used in extracted beam channel vacuum barriers. 13 refs.; 5 figs.; 2 tabs.

22928 (INS—702) **Development of a split coaxial RFQ at INS.** Arai, S.; Fukushima, T.; Morimoto, T.; Tojyo, E.; Tokuda, N.; Yoshizawa, M.; Hattori, T. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1988. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757227/JAW.

A split coaxial RFQ with modulated vanes is being developed at INS for acceleration of the unstable and stable nuclei with charge to mass ratio larger than 1/60. In order to make it easy to install the modulated vanes in a split coaxial resonator, a multimodule cavity structure has been employed. A feature of this structure is to be able to support the electrodes not only at one point but at several points. The rf characteristics of this structure have been investigated experimentally by means of a cold model with flat vanes and theoretically by using an equivalent circuit analysis. Based on these studies, a proton accelerating model working at a frequency of 50 MHz has bee constructed to evaluate the overall performance of this split coaxial RFQ. Through the beam test, it is confirmed that the accelerating performance of the RFQ approximately agrees with the expected one.

22929 (INS-T—485) **Fabrication of modulated vanes for a split-coaxial RFQ.** Fujino, T.; Arai, S.; Fukushima, T.; Sakamoto, N.; Tojyo, E. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1988. 23p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757235/JAW.

Modulated vanes installed in a split-coaxial RFQ have been fabricated at the INS machine shop. Each modulated vane, 205 cm long, is assembled by connecting 11 short vane pieces. They have been machined with an NC lathe operated like a milling machine. A ball end mill is mounted in the rotor and a vane piece is fixed by a special vise attached at the tool post; the vise moves vertically, and the tool post dose two-dimensionally in the horizontal plane. In the report, the development of the vise attachment, the calculation of the vane-tip geometry, the NC program, the machining process are described.

22930 (IRE—335(1987)) **Theory of generation of non-stationary signals in diffraction radiation generators.** Lukin, K.A.; Shestopalov, V.P.; Yakubenko, I.V. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki). 1987. 29p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706204/JAW.

Generalization of the nonlinear diffraction radiation general of non-stationary processes is proposed. An essential change of field's characteristics over the time of electron flight through the open resonator is typical of such processes. Uselessness of approximation of weak non-stability for the description of transient processes in generators, containing a diffraction grating with a great number of periods, is shown. The regimes of DRG frequency modulation at switching of accelerating voltage inside a zone are investigated, the reasons determining the time of setting the amplitude and frequency oscillation are discussed. The results of modeling of low-frequency modulation of oscillations in DRG at the cost of regular change of electron beam velocity with the period less than the flight time of electrons of the interaction length are given. 8 refs.; 9 figs.

22931 (IRE—348(1987)) **Autophasing: new direction of development of millimeter-wave relativistic electronics.** Eremka, V.D.; Zhurakhovskij, V.A.; Shestopalov, V.P. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706208/JAW.

An electron-optic crisis arising in classic schemes of the mm wave devices is considered while using high-current relativistic flows with large spread of velocities of charged particles. As a radical method of crossing the crisis it is suggested a principal refusal from the mechanism of inertial bunching in favour of more rough mechanisms of autophasing of the Vexler type and creation on its base a quantitatively new schemes of mm wavelength amplifiers, i.e. autophasing antiaccelerators, in particular, hyroresonance delayers of screw electron flows capable for radiation of Gwt powers with electron efficiency till 50-80%. 8 refs.; 4 figs.

22932 (JAERI-M—88-149, pp 87-91) **Charge induced type monitor for beam diagnostics.** Homma, Akira; Yamazaki, Hatsuo; Tsumori, Kunihiko. (Hokkaido Univ., Sapporo (Japan). Faculty of Engineering). Aug 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780071/JAW. (CONF-8803200—).

From 1. workshop on the free electron laser; Tokai, Japan (1 Mar 1988).

The response to a bunched electron beam of a beam monitor, a pick-up loop being used, for an electron linear accelerator was studied. It was found that dielectric material such as polyethylene around the loop affects the detected signal. The monitor described here is composed of the small wire loop held between two polyethylene disks in the plane perpendicular to the beam axis. Using the HOKUDAI 45 MeV LINAC (S-band) and the HANDAI 38 MeV LINAC (L-band), a single bunch signal and a bunch train signal was observed; 10 ns and 3 μs beam pulse for the S-band LINAC; single bunch and 8 ns beam pulse for the L-band LINAC. The applicability of this monitor for beam diagnostics, such as noninterceptive monitoring of beam position, current and waveform was also discussed.

22933 (JAERI-M—88-149, pp 103-105) **Study on electron injector of LINAC for FEL study at NERL, Univ. of Tokyo.** Kobayashi, H.; Ohashi, H. (Tokyo Univ., Tokai, Ibaraki (Japan). Nuclear Engineering Research Lab.). Aug 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780071/JAW. (CONF-8803200—).

From 1. workshop on the free electron laser; Tokai, Japan (1 Mar 1988).

Emittance of a beam accelerated by a linac is one of crucial parameters for free electron lasers(FEL). Main parameters of FEL project at Nuclear Engineering Research Laboratory(NERL) Univ. of Tokyo are reported by H. Ohashi et al. in this meeting. Here, design parameters of an electron gun is briefly reported.

22934 (JAERI-M—88-149, pp 106-110) **Preliminary test experiment for electron beam injection to JSR.** Mashiko, K.; Nobusaka, Y.; Ishizaki, N.; Tayama, H. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Aug 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780071/JAW. (CONF-8803200—).

From 1. workshop on the free electron laser; Tokai, Japan (1 Mar 1988).

A preliminary test experiment has been carried out to investigate the property of electron beam from the JAERI linac which will be used as an injector for the JSR(JAERI Storage Ring). The electron beam was obtained within the energy resolution of 1.55 % and the peak current of 38 mA at 150 MeV.

22935 **(JAERI-M—88-149) Proceedings of the free electron laser workshop, 1988 JAERI.** (Japan Atomic Energy Research Inst., Tokyo). Aug 1988. Vp. (CONF-8803200—). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780071/JAW.

From 1. workshop on the free electron laser; Tokai, Japan (1 Mar 1988).

Individual papers are indexed separately.

22936 (JINR-N—6-26-87, pp 12-16) **Application of VME bus and a Pravets-16 PC in a subsystem of the superconducting synchrotron cycle control.** Bazyleva, N.P.; Bazylev, S.N.; Efimov, L.G.; Kolpakov, I.F.; Nikiforov, A.S.; Senner, A.E.; Slepnev, V.M.; Smirnov, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01; INIS. Order Number DE89780076/JAW.

In JINR rapid communications. Collection.

The first application at JINR of the standard means for the construction of modern multiprocessor high-productive systems (VME bus) is considered. The embedding of the VME bus in a basic automation subsystem of the SPIN superconducting synchrotron allowed one to organize the common work of a MERA-60microcomputer, which controls the accelerator cycle, and a "Pravetz-16", which provides a dialogue with operator and controlling data calculation. Necessary set of VME modules as well as the corresponding microcomputer and PC software are designed. The achieved effect is to decrease the dead time required for changing the cycle parameters approximately by a factor of 300 in comparison with a uniprocessor version of the subsystem. The obtained experience of application and the VME possibilities will be used in the future for extending on the multiprocessor basis the range of superconducting synchrotron automation tasks to be solved in the SPIN synchrotron automation system. 5 refs.; 1 fig.

22937 (KURRI-TR—308, pp 35-38) **Console display system of KEK linac control.** Abe, Isamu; Fujieda, Masasi. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Sep 1988. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780083/JAW. (CONF-8709418—).

From 8. symposium on the development of advanced technology for scientific research; Kumatori, Japan (24 Sep 1987).

The control system of the Linac is based on a computerized communication network interconnecting the operator's main console with various terminal equipment. In this paper, the configuration of console display system are described.

22938 **(LA-UR—89-840) Spectrometer chopper for AHF and SSC low energy transports.** Hurd, J.W.; Thiessen, H.A. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—12). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009395/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

Presented is the study of a possible chopping system for the advanced hadron facility and the Superconducting Super Collider. A 200-MHz RFQ may be preferable to lower frequency structures for the injection linacs of AHF and SSC. To achieve a pulse frequency of 50 MHz, a chopper must be developed to eliminate three out of four bunches at the tenth of a percent level. Conventional choppers suffer from rise time limitations due to the finite separation of the deflecting plates. One alternative is a spectrometer chopper which modulates the energy of each bunch and then separates the bunches with a spectrometer transport. Initial design studies are presented for this concept. 5 refs., 4 figs., 1 tab.

22939 **(LA-UR—89-886) Variable gradient permanent-magnet quadrupole lenses.** O'Shea, P.G.; Zaugg, T.J.; Maggs, R.G.; Schafstall, P.; Dyson, J.E. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—41). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009386/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

Rare earth (RE) permanent-magnet quadrupoles (PMQs) have been used for many applications in particle accelerators. They have the advantage over electromagnets of being lightweight and reliable. One difficulty associated with PMQs is that the quadrupole gradient is not easily adjusted. Over a certain range, the magnetization of RE magnets is a reversible function of temperature. We have developed a scheme to use this property to make variable gradient PMQs. The field gradient changes required for tuning are typically on the order of a few percent. For many RE magnets, this

requires temperature changes of a few tens of degrees centigrade and is accomplished by actively heating or cooling the quadrupoles. 8 refs., 7 figs.

22940 **(LA-UR—89-910) A modular instrumentation panel for monitoring the status of accelerator cooling systems at Los Alamos.** Tomei, T.L.; Liska, D.J.; Clark, N.F. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 3p. (CONF-890335—21). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009288/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

A modular instrumentation panel has been designed and built for testing and installation on a linear accelerator at Los Alamos. This type of panel uses a modular approach to the monitoring of water-cooling system parameters. The panel design allows for its installation in various line sizes while using essentially the same design concept. The data taken from this instrumentation panel can be read locally or remotely and are used in several applications, namely, calorimetric measurements and fail-safe systems and alarms. A description of the panel and applications is presented. 4 figs.

22941 **(LA-UR—89-933) Advanced technology on the megawatt modulator for the ground test accelerator.** Yasotornrat, Hemtong. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—24). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009284/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

This paper presents the new concept of accelerator technology developed by Los Alamos National Laboratory, AT-Division. The modulator is driven on-off by rf switching power supply to achieve 1-MW rf accelerator energy from the klystron and klystrode at 850 MHz. The advantages are listed below: system cost saving up to 70%, operating cost saving up to 60%, weight reduced from 24,000 lbs. to 700 lbs., size reduced from 512 to 12 cu. ft., and efficiency improved from 75 to 97%. 2 figs.

22942 **(LA-UR—89-934) A technique for improving the accuracy and dynamic range of beam position-detection equipment.** Wells, F.D.; Jachim, S.P. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 3p. (CONF-890335—25). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009283/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

Beam position detection equipment often employs circuits that convert amplitude-modulated position signals to phase modulation. These signals are limited to remove amplitude variations and phase detected to obtain analog position information. The phase-modulated signals are clipped by limiters that must be closely phase matched in pairs over the signal intensity range of interest. Accuracy and dynamic range are determined principally by the phase match between the limiters. When the time duration of the beam is a few microseconds or more, significant improvements can be obtained by down-converting the rf signals to an intermediate frequency near 10 MHz. Limiter circuits are available that can be closely matched in pairs at 10 MHz over a 60-dB signal amplitude range. For example, the peak phase deviation measured among 30 matched pairs was $<0.4\{degree\}$, corresponding to a phase tracking error of <0.1 dB. This exceptional matching enabled beam position measurements over a 50-dB dynamic range of signal intensity. A description of the detection technique and the limiter is given by this paper. 6 refs., 6 figs.

22943 **(LA-UR—89-935) Photoelectric injector design code.** Carlsten, B.E. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—26). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009282/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

We will describe a computer code based on an analysis for an emittance growth mechanism for electron beams in photoelectric injectors. The analysis leads to a generic injector design with a single external solenoid used for both focusing the beam and reducing the correlated emittance. The position of the solenoid is given by a complicated integral expression, depending on the accelerating gradient and rf focusing. The computer code described here integrates this expression and calculates the best solenoid lens position for a given phasing and field amplitudes of the accelerating cavities. 5 refs., 2 figs.

22944 **(LA-UR—89-936) Coupling-impedance and response-characterization measurements of a Proton Storage Ring wall-current monitor.** Walling, L.S.; McMurry, D.; Thiessen, H.A.; Neuffer, D.V. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—35). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009281/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

This paper describes a method to measure the response of a beam current monitor and reports response and impedance measurement results for a Proton Storage Ring (PSR) wall current monitor.

22945 **(LA-UR—89-951) Beam loading and cavity compensation for the ground test accelerator.** Jachim, S.P.; Natter, E.F. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—31). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009275/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

The Ground Test Accelerator (GTA) will be a heavily beam-loaded H/sup minus/ linac with tight tolerances on accelerating field parameters. The methods used in modeling the effects of beam loading in this machine are described. The response of the cavity to both beam and radio-frequency (RF) drive stimulus is derived, including the effects of cavity detuning. This derivation is not restricted to a small-signal approximation. An analytical method for synthesizing a predistortion network that decouples the amplitude and phase responses of the cavity is also outlined. Simulation of performance, including beam loading, is achieved through use of a control system analysis software package. A straightforward method is presented for extrapolating this work to model large coupled structures with closely spaced parasitic modes. Results to date have enabled the RF control system designs for GTA to be optimized and have given insight into their operation. 6 refs., 10 figs.

22946 **(LA-UR—89-952) Development of the resonant-cavity virtual cathode and large-orbit gyrotron high-power microwave sources.** Fazio, M.V.; Hoeberling, R.F.; Kinross-Wright, J.; VanHaaften, F.; Stringfield, R.; Destler, W.W. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—20). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009274/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

At Los Alamos National Laboratory, research is continuing on the development of both the resonant-cavity virtual-cathode source and the large-orbit gyrotron high-power microwave source. The resonant-cavity virtual-cathode development effort has succeeded in demonstrating narrow-band single-mode operation of this typically wide-band source. This is accomplished by supplying feedback to the oscillating virtual cathode with a resonant-cavity structure. The large-orbit gyrotron effort is developing a method for efficiently coupling the microwave power from the device so that it can be easily used as a high-power microwave generator for accelerator applications. A repetitive pulse capability is also being developed for both microwave sources. Experimental results are presented in this paper. 3 refs., 7 figs.

22947 **(LA-UR—89-960) A 4-megavolt, 5-kiloampere pulsed-power high-brightness electron beam source.** Carlson, R.L.; Builta, L.A.; Kauppila, T.J.; Moir, D.C.; Ridlon, R.N.; Hughes, T.P. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—19). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009271/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

The REX machine at Los Alamos is being used to generate a 4-MW, 5-kA, 50-ns electron beam. The beam is produced by a planar velvet cathode, accelerated through a foilless anode aperture, and transported by an air core magnetic lens. Extensive measurements of the time-resolved (<1 ns) properties of the beam using a streak camera and high speed electronic diagnostics have been made. These parameters include beam current voltage, current density, and emittance for a single cathode/anode configuration. Results indicate beam brightness in excess of $10^8 A/m^2$-rad^2. Numerical simulations of the experiment have been performed with ISIS, a time-dependent PIC code, and are in good agreement with the measurements. This electron beam source is being considered as an injector to a linear induction accelerator and can be operated at higher voltages and currents as a stand-alone flash x-ray machine. 7 refs., 8 figs.

22948 **(LA-UR—89-963) Pulse-power-induced oscillations of the REX [Relativistic Electron-Beam Experiment] electron beam.** Builta, L.A.; Carlson, R.L.; Kauppila, T.J.; Moir, D.C.; Ridlon, R.N.; Hughes, T.P. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—18). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009270/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

The Relativistic Electron-Beam Experiment pulse power generator is used to produce a 4-MeV, 5-kA, 50-ns electron beam. The beam is produced by a planar velvet cathode. Multiple current rise times are used to examine pulse-power-induced beam oscillations. Diagnostics include a streak camera and high-speed electronic probes for monitoring current and voltage. Correlation between beam oscillations and TE/TM cylindrical cavity modes in the anode-cathode gap is examined. 2 refs., 9 figs.

22949 **(LA-UR—89-972) Pulsed 4-MeV electron injector with an excimer laser driven photocathode.** Kauppila, T.J.; Builta, L.A.; Carlson, R.L.; Moir, D.C.; Ridlon, R.N. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—17). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009269/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

The Relativistic Electron-Beam Experiment injector at the Los Alamos National Laboratory is used to generate a 4-MV pulse across an anode-cathode gap. A simple metal photocathode is illuminated by a pulsed excimer laser. Time-resolved measurements of current, voltage, and current density are made. The resulting quantum efficiencies are being used to obtain the required laser power for a multikiloampere, high-brightness electron gun to be used as an injector for a linear induction accelerator. 3 refs., 5 figs.

22950 **(LA-UR—89-976) Progress on a prototype main ring rf cavity.** Swain, G.; Kandarian, R.; Thiessen, H.A.; Poirier, R.; Smythe, W.R. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—36). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009267/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

A prototype rf cavity and rf drive system for a hadron facility main ring has been designed and will be tested in the Proton Storage Ring (PSR) at Los Alamos as a part of a collaborative effort between LANL and TRIUMF. The cavity uses an orthogonally biased ferrite tuner. The design provides for accelerating gap voltages up to 200 kV for the 49.3 to 50.8 MHz range. Progress on the cavity construction and testing is described. 13 refs., 5 figs.

22951 **(LA-UR—89-978) H/sup {minus}/ injection into the low-energy booster of the SSC [Superconducting Super Collider].** Colton, E.P.; Thiessen, H.A. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—38). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009353/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

Protons are accumulated into the low-energy booster of the SSC by utilizing H/sup {minus}/ $\rightarrow H^+$ conversion in a 225-$\mu g/cm^2$ carbon stripping foil. Synchronous injection is performed for 26 turns into stationary rf buckets, thereby allowing operation with variable bunch spacing. By injecting the beam offset in x and y we obtain the required rms normalized transverse emittance area of 0.75 π mm-mr. Similarly the required rms longitudinal emittance area of 1.75π {times} 10/sup {minus}3/ eVs is obtained by injecting single linac micropulses, centered at {phi} = 0, and dp/p = +0.12%, into each 49.9-MHz rf bucket formed with an rf voltage of 350 kV. The transverse space-charge tune shift is {minus}0.17 for 10^{10} protons/bunch accumulated at 600 MeV. 1 ref., 5 figs., 1 tab.

22952 **(SAND—88-2484C) Indirect measurement of HERMES III voltage.** Sanford, T.W.L.; Halbleib, J.A.; Poukey, J.W.; Ramirez, J.J.; Alexander, J.A.; Douglas, G.; Mock, R.; Sheridan, T. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 4p. (CONF-890335—5). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008277/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

The peak voltage at the Hermes III diode is measured to be 19 +- 2 MV by three indirect techniques that utilize parapotential flow theory, range of H/sup {minus}/ ions, and radiation output. Associated measurements of peak voltage along the MITL support the measured diode voltage and show that HERMES III operates as a balanced system, with each cavity contributing equally to the power pulse at the diode. 10 refs., 6 figs., 1 tab.

22953 **(SAND—88-2640C) Low emittance immersed and non-immersed foilless diodes for high current electron linacs.** Mazarakis, M.G.; Poukey, J.W.; Shope, S.L.; Hasti, D.E.; Smith, D.L.; Haworth, M.D.; Frost, C.A.; Leifeste, G.T.; Wagner, J.S. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 22p. (CONF-890335—6). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008226/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

A low emittance immersed foilless diode injector was designed and built for the upgraded RADLAC-II accelerator. The design is for a 5-MV, 40-kA annular beam with a 9-mm outer radius. A conical cathode field shaper eliminates the previously observed large cathode shank losses. The non-immersed foilless diode approach was utilized in the design of the Sandia recirculating linear accelerator (RLA) injector. A low energy design ({approximately}1.7 MV) and high energy (4 MV) design were carried out in conjunction with a solenoidal vacuum beam transport and injection system. 9 refs., 12 figs.

22954 **(SAND—89-0740C) High brightness immersed source injector characterization.** Frost, C.A.; Poukey, J.W.; Leifeste, G.T.; Hasti, D.E.; Jojola, J.M.; Jones, E.E. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 19p. (CONF-890335—10). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009071/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

RADLAC II is a high current linear induction accelerator for electrons. The beam is produced in a field-immersed foilless diode injector. We report the first time-resolved characterization of a similar high-brightness immersed diode source using a time-gated, 2-D x-ray imaging technique. The experiments were performed on the 4-MeV IBEX accelerator and produced currents exceeding 40 kA in a 6-mm radius, thin annular beam with a measured thermal transverse velocity v/sub {perpendicular}/ = β/sub {perpendicular}/c ~ 0.1c. For currents of 30 kA, even brighter beams with β/sub {perpendicular}/ = 0.07 were obtained. At lower currents, beams as small as 2 mm in radius were produced with a smaller cathode tip. In all cases, the measured parameters were consistent with 2-D PIC simulations. The experimental results will be discussed and compared to theory and simulations. 7 refs., 10 figs., 1 tab.

22955 **(SLAC-PUB—4896) Fast energy spectrum and transverse beam profile monitoring and feedback systems for the SLC linac.** Soderstrom, E.J.; Abrams, G.S.; Weinstein, A.J.; Brown, R.L.; Gromme, T.E.; Jacobsen, R.G.; Seeman, J.T.; Zicker, J.E. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1989. Contract AC03-76SF00515. 4p. (CONF-890335—9-Vugraphs). NTIS, PC A02 - OSTI. Order Number DE89008989/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

Fast energy spectrum and transverse beam profile monitoring systems have been tested at the SLC. The signals for each system are derived from digitizations of images on phosphor screens. Individual beam bunch images are digitized in the case of the transverse profile system and synchrotron radiation images produced by wiggler magnets for the energy spectrum. Measurements are taken at two-second intervals. Feedback elements have been installed for future use and consist of rf phase shifters to control energy spectrum and dipole correctors to control the beam launch into the linac affecting the transverse beam profile. Details of these systems, including hardware, timing, data acquisition, data reduction, measurement accuracy, and operational experience will be presented. 9 refs.

22956 **(SLAC-PUB—4900) Design of a 100 MW X-band klystron.** Eppley, K. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1989. Contract AC03-76SF00515. 4p. (CONF-890335—8-Vugraphs). NTIS, PC A02 - OSTI. Order Number DE89008939/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

Future linear colliders will require klystrons with higher peak power at higher frequency than are currently in use. SLAC is currently designing a 100 MW klystron at 11.4 GHz as a prototype for such a tube. The gun has been designed for 440 KV and 510 amps. Transporting this beam through a 5 mm radius X-band drift tube presents the major design problem. The area convergence ratio of 190 to one is over ten times higher than is found in conventional klystrons. Even with high magnetic fields of 6 to 7 kilogauss careful matching is required to prevent excessive scalloping. Extensive EGUN and CONDOR simulations have been made to optimize the transmission and rf efficiency. The EGUN simulations indicate that better matching is possible by using resonant magnetic focusing. CONDOR calculations indicate efficiencies of 45 percent are possible with a double output cavity. We will discuss the results of the simulations and the status of the experimental program. 3 refs., 6 figs., 2 tabs.

22957 **Ultra-cold jet of polarized atomic hydrogen.** Raymond, R.S.; Crabb, D.G.; Roser, T.; Court, G.R. (University of Michigan, Ann Arbor, MI 48109). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1132-1133(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Equipment is being tested to determine the applicability of cryogenic atomic physics techniques to the production of dense polarized atomic hydrogen beams. Such beams, with expected densities of 10/sup 14//cm^3, would be useful for internal targets.

4304 Storage Rings

22958 **(CONF-890335—28) Design, construction, and field mapping of the HISTRAP prototype dipole.** Tatum, B.A.; Dowling, D.T.; Lord, R.S.; Mosko, S.W.; Olsen, D.K. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008920/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

HISTRAP is a proposed 2.67 T-m synchrotron-cooler-storage ring having eight 45{degree}, C-design dipole magnets. A prototype dipole has been designed, fabricated, and mapped. The magnet design utilizes curved and angled coil ends to compensate for end effects in the field. Construction of the prototype dipole has been completed by the FNAL magnet factory. The magnetic field has been mapped using a Hall-effect probe afixed to a newly constructed, PC-based, horizontal positioning system. Results of the field mapping are presented. 6 refs., 7 figs., 1 tabs.

22959 **(CONF-890335—29) Prototype rf cavity for the HISTRAP accelerator.** Mosko, S.W.; Dowling, D.T.; Olsen, D.K. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008927/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

HISTRAP, a proposed synchrotron-cooling-storage ring designed to both accelerate and decelerate very highly charged very heavy ions for atomic physics research, requires an rf accelerating system to provide {+-}2.5 kV of peak accelerating voltage per turn while tuning through a 13.5:1 frequency range in a fraction of a second. A prototype half-wave, single gap rf cavity with biased ferrite tuning was built and tested over a continuous tuning range of 200 kHz through 2.7 MHz. Initial test results establish the feasibility of using ferrite tuning at the required rf power levels. The resonant system is located entirely outside of the accelerator's 15cm ID beam line vacuum enclosure except for a single rf window which serves as an accelerating gap. Physical separation of the cavity and the beam line permits in situ vacuum baking of the beam line at 300{degree}C.

22960 (JAERI-M—88-149, pp 22-28) **High gain FEL attached to a storage ring.** Yamada, K.; Wakuta, Y. (Kyushu Univ., Fukuoka (Japan). Faculty of Engineering). Aug 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780071/JAW. (CONF-8803200—).

From 1. workshop on the free electron laser; Tokai, Japan (1 Mar 1988).

A preliminary design study has been done on a high gain free electron laser which is bypassed from 1.3 GeV storage ring sustaining a good electron beam quality required for the operation. Typical parameters obtained to produce coherent radiation of 1000 A wave length with 225 MW peak power are shown. The designed high gain FEL is supposed to be installed 5 m below the median plane of the storage ring under consideration at Kyushu University.

22961 (JAERI-M—88-149, pp 35-39) **Beam properties of UVSOR.** Kasuga, T. (Okazaki National Research Inst., Aichi (Japan). Inst. for Molecular Science). Aug 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780071/JAW. (CONF-8803200—).

From 1. workshop on the free electron laser; Tokai, Japan (1 Mar 1988).

Fundamental researches on free electron laser(FEL) and being made in the UVSOR which is a 750 MeV electron storage ring for synchrotron light source. The one-pass gain of FEL is proportional to the electron density in a bunch. Various phenomena which reduce the density are reported.

22962 (JAERI-M—88-149, pp 46-52) **Present status of ETL-SRFEL.** Yamazaki, T.; Nakamura, T.; Tomimasu, T.; Sugiyama, S. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). Aug 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780071/JAW. (CONF-8803200—).

From 1. workshop on the free electron laser; Tokai, Japan (1 Mar 1988).

Outline is presented of the present status of ETL-SRFEL(Electrotechnical Laboratory storage ring free electron laser experiment). A modification of ETL-TOK(transverse optical klystron) has decreased the degradation of spontaneous-emission spectrum due to anomalous energy spread of the electron beam. Measurement of optical-cavity loss is under way. Some tests on RF-KO are being carried out in order to reduce the bunch number of the stored beam from 18 to 3.

22963 (JAERI-M—88-149, pp 57-59) **JAERI small storage ring.** Yokomizo, H.; Sasaki, S.; Suzuki, Y. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Aug 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780071/JAW. (CONF-8803200—).

From 1. workshop on the free electron laser; Tokai, Japan (1 Mar 1988).

A small storage ring is under construction in JAERI in order to understand the basic accelerator physics and to study the new accelerator technologies for aiming at a large storage ring facility(6 GeV). The electron beam with the energy of 150 MeV is provided by the old linac which has been mainly used for the neutron cross section study. The storage energy is gradually increased up to 300 MeV after the injection. The circumstance of the ring is {similar←to} 20 m. This storage ring will be operational in March, 1989.

22964 **(LA-UR—88-4266) A muon storage ring for neutrino beams.** Lee, W.; Neuffer, D. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 14p. (CONF-8809223—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009279/JAW.

From Workshop on new directions in neutrino physics; Batavia, IL, USA (14 Sep 1988).

A muon storage ring can provide electron and muon neutrino beams of precisely knowable flux. Constraints on muon collection and storage-ring design are discussed. Sample muon storage rings are presented and muon and neutrino intensities are estimated. Experimental use of the ν-beams, detector properties, and possible variations are described. Future directions for conceptual designs are outlined. 11 refs., 4 figs., 3 tabs.

22965 **(LA-UR—89-977) Design for a second-generation proton storage ring at LAMPF.** Colton, E.P. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—37). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009354/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

A conceptual design is presented for a second-generation proton storage ring complex at LAMPF. The facility would consist of two stacked racetrack-shaped machines. These machines would deliver a 1.2-mA beam of 1.6-GeV protons at 48 Hz. The pulse length would be 1.75 μsec which represents a time compression of 570. 3 refs., 4 figs., 1 tab.

22966 **(LA-UR—89-981) Observation of the tune dependence of the stability threshold current in the PSR [Proton Storage Ring].** Wang, Tai Sen F.; Colton, E.; Lombardi, A.; Neuffer, D.V.; Thiessen, H.A. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—39). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009352/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

In the high-intensity unbunched-beam experiments carried out in the Proton Storage Ring at Los Alamos National Laboratory, the threshold current of vertical transverse instability showed pronounced differences when the betatron tune varied across an integer. In this paper, we shall present our experimental observations and discuss the possible relations between the threshold current and the machine impedance. The possible effects related to the distorted closed orbit are also discussed. 5 refs., 3 figs., 1 tab.

22967 **(LA-UR—89-1045) Transverse collective instability in the PSR [Proton Storage Ring].** Colton, E.P.; Neuffer, D.; Swain, G.; Thiessen, H.A.; Lombardi, A.; Wang, T.S. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—30). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009345/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

An instability in the proton storage ring (PSR) is observed as fast loss of beam during accumulation and storage when the injected beam current exceeds a threshold value. Instabilities are observed during both coasting-beam and bunched-beam operation. Large coherent transverse oscillations occur prior to and during the beam loss. The growth times are rapid, typically in the range 10–100 μs. The instability threshold is observed to depend strongly upon rf voltage, beam size, injected momentum spread and nonlinear fields. Weaker dependences upon betatron tune, vacuum pressure, and stripping-foil bias voltage have also been observed. A possible e-p oscillation component of the unbunched beam instability is suggested. Growth times suggest a significant Re(Z{perpendicular}) of {approximately}0.2–0.5 MΩ/m; the source of this is not yet precisely identified. 4 refs., 3 figs., 1 tab.

22968 **(NIKHEF-K-APS—88-02) Misalignments, allowable multipole field content, basic injection parameters and basic RF parameters.** Maas, R.; Servranckx, R.; Wu, Y. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands)). May 1988. 6p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706266/JAW.

Soon the main hardware components of the NIKHEF ring will have to be ordered and the design of special elements will have to start. Data are provided that are needed for these steps of the evolution of the project. 1 figure; 3 tabs.

22969 **Status report on the Los Alamos proton storage ring.** Colton, E.; Neuffer, D.; Thiessen, H.A.; Butler, H.; Swain, G.R.; Lombardi, A.; Fitzgerald, D.; Mariam, F.; Plum, M.; Ryder, R.; and others. (Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 302-308(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The proton storage ring currently operates at an average current of 30 μA corresponding to 1.25 x 10/sup 13/ protons per pulse (ppp) at a repetition rate of 15 Hz. The design operating current for the machine is 100 μA. We are limited to running at the reduced yield because of beam losses during the accumulation period. These losses are understood and arise mainly from emittance growths during the injection and multiple scattering in the stripping foil during the storage. During beam studies we have succeeded in accumulating in excess of 3.7 x 10/sup 13/ ppp. We have also observed a coherent transverse instability at high charge levels. The signture for the instability is rapid coherent growth of the transverse beam size followed by a loss of beam in the machine. The threshold for the instability depends most strongly upon rf voltage and beam size.

22970 **First operation of the Fermilab polarized beam.** Underwood, D.G. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1118-1122(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We describe the first operation of a 200 GeV/c pp-beam at Fermilab, including beam tuning and momentum and polarization tagging. The present status of analysis of the data from two polarimeter experiments is described here. A third experiment is described in a separate paper.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 21883, 21885, 22589, 22902, 23382, 23383, 23399, 23410, 23416, 23684, 23891, 23904

22971 **(ANL/PPRNT—89-175) An improved method for statistical analysis of raw accelerator mass spectrometry data.** Gutjahr, A.; Phillips, F.; Kubik, P.W.; Elmore, D. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 13p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008475/JAW.

Hierarchical statistical analysis is an appropriate method for statistical treatment of raw accelerator mass spectrometry (AMS) data. Using Monte Carlo simulations we show that this method yields more accurate estimates of isotope ratios and analytical uncertainty than the generally used propagation of errors approach. The hierarchical analysis is also useful in design of experiments because it can be used to identify sources of variability. 8 refs., 2 figs.

22972 **(BNL—41235) Reduction in non-linearity in position-sensitive MWPCs.** Mathieson, E.; Smith, G.C. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 6p. (CONF-881103—59). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008147/JAW.

From IEEE nuclear science symposium; Orlando, FL, USA (9 Nov 1988).

Measurements of differential non-linearity have been made, with a small multiwire proportional chamber, for two special cathode strip geometries. The results have been compared with that for conventional strip geometry, and with theoretical predictions. With the ratio of sampling node separation to anode, cathode separation at the exceptionally large value 2.4, a peak-to-peak differential non-linearity of 72% was observed for the conventional geometry. The first special geometry employed two intermediate strips between the readout strips. By using near optimum capacitive coupling between strips, a differential non-linearity of about 4% has been achieved at the same ratio 2.4. In the second special geometry, cathode strips with optimum depth zigzag shaped boundaries yielded an experimental differential non-linearity of about 7%. 11 refs., 10 figs., 1 tab.

22973 **(BNL—42175) A TPC for large solid angle relativistic ion experiments.** Etkin, A.; Eiseman, S.E.; Foley, K.J.; Hackenburg, R.W.; Longacre, R.S.; Love, W.A.; Morris, T.W.; Platner, E.D.; Saulys, A.C.; Lindenbaum, S.J. (Brookhaven National Lab., Upton, NY (USA); City Coll., New York (USA); Johns Hopkins Univ., Baltimore, MD (USA); Rice Univ., Houston, TX (USA)). 4 Nov 1988. Contract AC02-76CH00016;AC02-83ER40107;AC02-76ER03274;AS05-81ER40032. 6p. (CONF-881103—58). NTIS, PC A02 - OSTI. Order Number DE89008163/JAW.

From IEEE nuclear science symposium; Orlando, FL, USA (9 Nov 1988).

A TPC detector system has been developed to function in the very high multiplicity environment of relativistic heavy ion experiments. A TPC was chosen because it directly gives 3-dimensional points on the tracks which is very significant help for track finding. Of prime importance is a combination of high efficiency, low noise and two-track resolution capability. A significant development is a system of hybridized high sensitivity on chamber digitizing electronics. A description of the TPC modules, the digitizing electronics and test results are given. 9 figs.

22974 **(BNL—42189) Some TPC [Time Projection Chamber] measurements in an oxygen beam at the AGS.** Love, W.A.; Bonner, B.E.; Buchanan, J.A.; Chan, C.S.; Chiou, C.N.; Clement, J.M.; Corcoran, M.D.; Etkin, A.; Foley, K.J.; Hackenburg, R.W. (Brookhaven National Lab., Upton, NY (USA); City Coll., New York (USA); Johns Hopkins Univ., Baltimore, MD (USA); Rice Univ., Houston, TX (USA)). 15 Nov 1988. Contract AC02-76CH00016;AC02-76ER03274;AC02-83ER40107;AS05-81ER40032. 7p. (CONF-8809203—5). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008180/JAW.

From Quark Matter '88: 7th international conference on ultrarelativistic nucleus-nucleus collisions; Lenox, MA, USA (26 Sep 1988).

The principal detector for AGS Experiment 810 is a Time Projection Chamber (TPC) in which it is intended to measure momenta and angles of a major fraction of the charged particles from each light ion collision. This report describes the results of a test of a prototype of the TPC in a beam of (14.6 {times} 16 = 233.6 GeV/c) oxygen ions run in June of this year.

22975 **(CONF-890268—2) Radiation rate meter development.** Thacker, L.H. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007523/JAW.

From Joint service radiac working group meeting; Albuquerque, NM, USA (21 Feb 1989).

We are still in a very preliminary stage of examining the potentials of a new series of instruments which may be inexpensive and versatile enough to complement, or conceivably even replace, electroscope dosimeters in Civil Defense and other situations requiring radiation monitoring by the general public. These instruments were developed to provide a qualitative signal so simple to interpret that anyone can tell immediately whether they are in a dangerous radiation field, and whether they are moving into a hotter area or a cooler area. A second goal in the development has been to produce the simplest possible device at minimum cost, without compromise in effectiveness. In the simplest implementation the device is essentially a very inexpensive version of the much older Personal Radiation Monitor (PRM).

22976 **(FNAL/C—89/21-E) Performance of 0.75 mm pitch MWPC'S operating at high rate.** Conetti, S.; Kuzminski, J.; Marchionni, A.; Stairs, D.; Arenton, M.; Chen, T.Y.; Cox, B.; Delchamps, S.; Etemadi, B.; Fortney, L. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1989. Contract AC02-76CH03000. 6p. (CONF-881103—47). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007483/JAW.

From IEEE nuclear science symposium; Orlando, FL, USA (9 Nov 1988).

Three Multiwire Proportional Chambers (MWPC) with high rate capability have been constructed for Fermi National Accelerator Laboratory experiment 705 (Charmonium and Direct Photon production by π/sup +-/, p and {bar←p} at 300 GeV/c). Each chamber, with a sensitive area of 308 cm^2, consists of three anode planes, wound with 12.5 μm diameter gold-plated tungsten/rhenium wire, facing 25 μm graphite-coated kapton cathode planes at a distance of 3 mm. Wire spacing in two of the MWPC (PC-B1 and PC-B2) is 0.75 mm and 1.00 mm in the third one (PC-B3). After a few weeks of running on "Magic Gas" with a beam flux of up to {approximately}10^7 particles/cm^{2}sec, severe damage occurred to the graphite coating. All cathode planes were replaced by aluminized kapton, and the chambers worked successfully for the next 3 months until the end of the run, when a 10% efficiency drop was observed after a total accumulated charge of {approximately}1 C/cm of sense wire. After the end of the run the chambers were disassembled and inspected. A white deposit with a characteristic "wire pattern" etched away from the Al coating was observed in the region of the beam spot. 10 refs., 8 figs., 1 tab.

22977 **(FNAL-TM—1558) Response of the D0 Muon Chamber to changes in voltage, incident angle, gas composition, and oxygen contamination.** Oshima, N.; Igarashi, S. (Fermi National Accelerator Lab., Batavia, IL (USA)). 24 Feb 1989. Contract AC02-76CH03000. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009699/JAW.

The measured space point resolution of a D0 Muon Chamber is {+-}0.31 mm perpendicular to the anode wire and 2.7 mm parallel to the wire. A voltage change of 1 kV, which changes the gas gain by a factor of 50, only causes a change of drift velocity of 12%. Tracks inclined of 45{degree} have a resolution worse than those of 0{degree} by a factor 3 {+-} 2. A change in gas composition from CO_2(10%) to CO_2(11%) decreases the gas gain by 17 {+-} 5%, and decreases drift velocity by 0.2 {+-} 0.2%. The effect of an oxygen contamination of 3200 ppM is to change the mean pulse height by 45% over the 5 cm width of the cell. 4 refs., 15 figs.

22978 **(IAEA-AL—002) Principles of radiation detection.** Czock, K.H. (International Atomic Energy Agency, Vienna (Austria)). Feb 1988. 134p. NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS. Order Number DE88705643/JAW.

After a short description of the ionizing radiations and their interactions with matter, the properties and functions of radiation detector systems in general and of the scintillation and semiconductor detectors in particular are presented. Figs and tabs.

22979 **(ICEFIZ-NP—62-1987) Computer programs for the analysis of gamma ray spectroscopy data.** Duma, M.; Iacob, V.E.; Trache, L. (Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania)). (Central Inst. of Physics, Bucharest (Romania)). Nov 1987. 41p. (In Romanian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706019/JAW.

The set of computer programs realised in the TANDEM laboratory of the Heavy Ion Physics Department of IPNE for the analysis of gamma ray spectroscopy data is presented. (authors).

22980 **(ICR—177-88-23) Search for correlation of neutrino events with solar flares in Kamiokande.** Hirata, K.S.; Kajita, T.; Kifune, T. and others. (Tokyo Univ., Tanashi (Japan). Inst. for Cosmic Ray Research). Oct 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757226/JAW.

A search has been made for a correlation between large solar flares and neutrino events observed in Kamiokande for the period of July 1983 - July 1988. No significant neutrino signal was found at the time of a solar flare, giving a limit on the time integrated 'solar-flare' ν/sub e/ flux $<$ 3.7 x 10/sup 7/ (2.5 x 10/sup 9/)/cm/sup 2/ per flare at 90 % confidence level, for E/sub ν/ = 100 (50) MeV. These limits are 2000 (60) times smaller than the value required for neutrinos with those energies to account for the excess of signal in the /sup 37/Cl solar neutrino experiment at some of the corresponding solar flare times.

22981 (INIS-BR—1440, pp 39) **Optimization of time-of-flight spectrometer using /sup 22/Na.** Santos, G.R. dos; Goncalves, Z.C. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22982 (INIS-BR—1440, pp 14) **Modifications in the FANTI computer code and preparation of a version for microcomputers.** Antunes, L.J. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22983 (INIS-BR—1440, pp 55) **Performance testing of FANTI computer code.** Antunes, L.J.; Suita, J.C. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22984 (INIS-BR—1440, pp 61) **Calculation and mounting of a new response matrix for NE-213 detector.** Antunes, L.J. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

22985 **(INT—192/E) Charge-sensitive preamplifier for gas proportional counters.** Dabrowski, W. (Institute of Physics and Nuclear Techniques, Krakow (Poland)). 1985. 9p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706203/JAW.

A low noise charge-sensitive preamplifier for gas proportional counters is described. In the preamplifier a simple shaping circuit was designed to improve the baseline stability at high count rates. A low thermal coefficient of the total gain was achieved as a result of the appropriate temperature compensation. 2 refs., 3 figs.

22986 **(JAERI-M—88-212) Design of the optical system for a new time-resolved X-ray absorption spectroscopy apparatus.** Miyashita, Atsumi; Yoda, Osamu. (Japan Atomic Energy Research Inst., Takasaki, Gunma. Takasaki Radiation Chemistry Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Oct 1988. 54p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88757253/JAW.

Calculations of total reflection mirror optics and analyzing crystal polychromator optics are done to design a new time-resolved soft X-ray absorption spectroscopy apparatus. This apparatus utilizes pulsed soft X-rays of pseudo-continuum energy which are generated by a pulsed laser-induced metal plasma, and covers an energy range of 90 eV {similar←to} 3 keV. An optimal design of the optical system, i.e. optimal dimensions, setting positions and materials of the mirror and polychromator, is proposed based on the calculations of the reflectivity of the material, efficiency of the X-ray acceptance and ray-tracing. Calculations are also made on the reflectivity of several mirror materials commonly used for the X-ray diffraction and spectroscopy in the energy range up to 50 keV. Data of the reflectivity in this energy region are necessary to design an X-ray apparatus using synchrotron radiation as an X-ray source. Numerical results of the reflectivity are available from the author.

22987 (JINR—N-1-27-88, pp 8-11) **FASTBUS system for measurement of analogue signals for the SPHERE spectrometer.** Afanas'ev, S.V.; Zarubin, P.I.; Kolpakov, I.F. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01; INIS. Order Number DE89780078/JAW.

In JINR rapid communications. Collection.

The FASTBUS system for measurment of analogue signals at the SPHERE installation is described. The system is based on 16-channel 8-bit flash ADC FASTBUS module, standard FIORI interface module connected with CAMAC input/output registers realizes data transmission between FASTBUS and CAMAC dataways. Operation of the system is controlled by the Elektronika-60 microcomputer connected to the CAMAC crate controller. Software used in the system permits one to realize communication between FASTBUS dataway and computer, module testing, data acquisition and processing, and the result representation as a histogram. The described system was applied at the SPHERE experimental stand for measuring the characteristics of scintillation hodoscopes. 7 refs.; 2 figs.

22988 (JINR—N-3-29-88, pp 27-32) **About discrepancy in values of deuteron binding energy measured with semiconductor detectors and crystal-diffraction gamma-spectrometer.** Ivanov, A.I.; Uchevatkin, I.F.; Vylov, Ts.; Gorozhankin, V.M.; Pokrovskij, V.N. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Metrologii, Leningrad (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780080/JAW.

In JINR rapid communications. Collection.

The recently discovered marked discrepancy in value of deuteron binding energy Sn(/sup 2/H) as measured with Ge(Li) and CD spectrometers, may be of primary importance as the energetic scale of spectrometers, is based on crystal-diffraction spectrometer data. The measurement of γ-rays in the /sup 1/H(n, γ) reaction was repeated and earlier results on Sn(/sup 2/H) with Ge(Li) spectrometers were confirmed. At the same time the Ge(Li) data on γ-rays located in the same 2 MeV region from /sup 35/Cl(n, γ) reation obtained in this work are in complete agreement with CD data. So the above-mentioned discrepancy holds and needs further investigations. 14 refs.; 3 figs.; 1 tab.

22989 **(JINR-E—15-88-137) Vasilisa facility for the electrostatic separation and study of complete fusion reaction products.** Eremin, A.V.; Andreev, A.N.; Bogdanov, D.D. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1988. 10p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706234/JAW.

Submitted to the journal Nucl. Instrum. Methods.

The VASSILISSA facility is described, the main component of which is an electrostatic separator of complete-fusion reaction products from the ion beam. The facility is capable of transmitting recoil nuclei emitted by the target in the beam direction within a solid angle of 10/sup -2/ sh and having a +-10% spread in energy and ionic charge. The time required to transport the nuclei to detectors is 3x10/sup -6/ s. The separation of scattered ions is performed using a system of three electrostatic condensers. Separation factors are obtained for Ar, P and Ne to be equal to 10/sup 10/, 10/sup 11/ and 10/sup 12/ respectively. 21 refs.; 3 figs.; 1 tab.

22990 **(JINR-R—1-88-29) Reaction vertex determination in coordinate detectors.** Yatsunenko, Yu.A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1988. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706236/JAW.

Submitted to the journal Nucl. Instrum. Methods.

For multiquark reconstruction problem a mathematical model is suggested. This model is defined as an integral along the sought trajectory on function, alternatively including all the coordinates from each detector. Position of principal maxima of the model in the space of trajectory parameters determine trajectories. Due to this model it is possible to determine vertex position without the previous track reconstruction for straight trajectories. 7 refs.; 5 figs.

22991 **(JINR-R—1-88-156) Pion dissociation event selection inside the ten-layer silicon target.** Petrov, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1988. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706240/JAW.

A possibility of making a set-up for fast analysis of analogous information from multilayer silicon target-detector is considered. The efficiency of registration of pion dissotiation events and coefficients of interaction suppression outside a target and interactions on quasifree protons have been computed by the Monte Carlo method. The feasibility of creating such an instrument and its using in fast trigger ıogic are shown. 8 refs.; 3 figs.; 3 tabs.

22992 **(JINR-R—3-88-315) Setup for neutron investigation of condensed media under high pressure at reverse geometry spectrometer.** Habrylo, S.; Bragin, S.I.; Brankowski, J. and others. (Uniwersytet Adama Mickiewicza, Poznan (Poland). Inst. Fizyki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1988. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706250/JAW.

Submitted to the journal Prib. Tekh. Ehksp. .

In order to enable neutron scattering investigations of various properties of condensed matter under high pressure and different temperatures, the KDSOG-M spectrometer has been equipped with a special setup. It permits to measure simultaneously spectra of neutron diffraction and inelastic incoherent scattering. The setup contains; the GCA-10A gas compressor with a maximum pressure of 1500 MPa, a specially designed high pressure cell with the system to feed and measure the pressure, a liquid helium cryostat with a temperature controller capable of stabilizing the temperature of the pressure cell within the range of 10K-300K. Technical and physical parameters of the setup are reported along with some experimental results obtained for a coherent scatter (CCl/sub 4/) and an incoherent one (C/sub 6/H/sub 11/OH, d-C/sub 10/H/sub 16/O) under the pressure of 400 MPa. 10 refs.; 8 figs.

22993 **(JINR-R—10-88-210) Event reconstruction in experiments with separation of reaction channels by missing mass method on Hyperon facility.** Vinogradov, V.B.; Kurilin, A.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1988. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706255/JAW.

The methods of trajectory reconstruction and determination of kinematic parameters of charged particles used when studying hypercharged reactions π/sup +/p -> K/sup +/Σ/sup +/, Σ/sup +/(1385) and π/sup +/n -> K/sup +/Λ, Σ/sup 0/ with the help of "Hyperon" facility are described. The main stages of event treatment are presented. The application of these methods has provided a necessary resolution for separation of the channels of the mentioned reactions by the missing mass method. 21 refs.; 6 figs.

22994 **(JINR-R—10-88-275) Digital dynamic amplitude-frequence spectral analyzer.** Kalinnikov, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1988. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706256/JAW.

Submitted to the journal Prib. Tekh. Ehksp. .

A software and hardware for the digital dynamic spectral analysis realization is described. A new method of recurrent calculation of spectral coefficients is proposed. The analyser is made in the CAMAC standard. ECL, TTL J C (297 chips) are used as an element base. Time for calculation of 16 coefficients of spectral density is 30 μs. 10 refs.; 4 figs.

22995 **(JINR-R—13-87-937) Advances in the development of apparatus and methods for studies of protein monocrystals in coordinate X-ray diffractometers based on two-dimensional proportional chambers.** Andrianova, M.E.; Popov, A.N.; Khejker, D.M.; Zanevskij, Yu.V.; Ivanov, A.B.; Movchan, S.A.; Peshekhonov, V.D.; Chernenko, S.P. (AN SSSR, Moscow. Inst. Kristallografii). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; AN SSSR, Moscow. Inst. Kristallografii). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706259/JAW.

Results of X-ray structure studies of protein monocrystals performed by means of the KARD-3 and KARD-4 diffractometers based on two-dimensional X-ray detectors are presented. Over 60 total sets of intensity patterns with a high resolution have been obtained for a variety of proteins. The data make it possible to determine the spatial structure of a series of proteins which are of great interest from the scientific and practical viewpoints. The main parameters of new developed X-ray detectors are given.

22996 **(JINR-R—13-88-278) Search the spectrometric characteristics of microchannel plate photomultipliers.** Wawryszczuk, J.; Lewandowski, M.; Yutlandov, I.A.; Ivanov, A.I.; Isaak'yan, G.A.; Uchevatkin, I.F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Metrologii, Leningrad (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1988. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706260/JAW.

Several photomultilpliers based on microchannel plates have been investigated. Their high time characteristics are proved. the photomultipliers of this type are shown to have a satisfactory energy resolution. 13 refs.; 4 figs.; 1 tab.

22997 (JINR-R—13-88-308) **Determination of polarization parameters of a deuteron polarized target by experimental data.** Liburg, M.Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1988. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706261/JAW.

A method for deuteron magnetic resonance (DMR) treatment is proposed. It is used for calculating polarization parameters of targets with deuterium polarized nuclei. Using symmetry properties, total DMR spectrum could be presented as a sum of two curves describing energy absorption at transitions between neighbouring magnetic levels. The least square criterion is applied to find the best values for line-shape function parameters. One of two parameters was used to calculate polarization and alignment with an accuracy not worse than 2%. The second one, B, being independent on polarization, is a constant for the present target material. Knowing the numerical value B and peak heights of the observed DMR-spectrum in maximum it is easy to calculate polarization parameters of a target. Results on ethanediol and 1,2-propanediol DMR spectrum treatment are presented. Formulae for estimating the quadrupole splitting contribution into the measured values of polarization parameters are presented, the method for calculating the latters for the case when this contribution is essential is shown. 9 refs.; 2 figs.

22998 (KEK—88-6, pp 116-139) **High energy particle/nuclear astrophysics with emulsion chambers.** Takahashi, Yoshiyuki. (Alabama Univ., Huntsville (USA). Dept. of Physics). Sep 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE89780072/JAW. (CONF-8802137—).

From Workshop on physics of quark-gluon-plasma; Tsukuba, Japan (18 Feb 1988).

Several selected issues of high energy cosmic ray astrophysics with regard to the origin of high energy nuclei are presented. Relevant observational advancement achieved in the past decade by HEAO-3 satellite, CRNE SPACELAB-2 experiment, and the balloon-borne JACEE emulsion chambers are summarized. Significant problems engendered from these observations rendered some new expectations. Observability of high energy nuclei from explosive nucleo-synthesis with pulsar-acceleration has come into our scope of view more seriously than before. Further observations of high energy nuclei are demanding innovative, and large-scale detectors in space, for which a few examples of planned observations are introduced with an emphasis on the use of advanced emulsion chamber technology. New techniques in determining very high primary energies are discussed. In particular, efforts which include charge (and energy) measurements with transition radiation detection, and isotopic evaluation via heavy-ion interactions, are explained. Finally, a concept of a Super-JACEE experiment, dedicated for heavy-ion studies in space, is briefly presented.

22999 (KEK-PR—88-1, pp 28-50) **Search for nucleon decay in KAMIOKANDE-II, present status.** Hirata, K.S.; Kajita, T.; Koshiba, M. and others. (Tokyo Univ. (Japan). Faculty of Science). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780073/JAW. (CONF-8802136—).

From 2. workshop on elementary-particle picture of the universe; Tsukuba, Japan (4 Feb 1988).

We have searched for 2-body nucleon decay signals using the KAMIOKANDE-II data. No evidence for nucleon decay have been observed yet above the atmospheric neutrino background. Limits on nucleon lifetime for various decay modes are obtained using KAMIOKANDE-I and -II data. The background subtracted lifetime limits at 90 % C.L. range from 0.9 to 19 x 10/sup 31/ yr depending on the decay modes. Especially for the decay modes $e\pi$/sup 0/, νK/sup +/ and νK/sup 0/, the lifetime limits are 19, 6.4 and 6.1 x 10/sup 31/ yr, respectively.

23000 (KEK-PR—88-1, pp 73-80) **Search for high energy neutrinos from dark matter annihilation in the sun.** Hirata, K.S.; Kajita, T.; Kifune, T. and others. (Tokyo Univ. (Japan). Faculty of Science). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780073/JAW. (CONF-8802136—).

From 2. workshop on elementary-particle picture of the universe; Tsukuba, Japan (4 Feb 1988).

Recent theoretical studies have indicated that weakly interacting massive particles(WIMP's) might be dark matter candidates explaining 'the missing mass problem'. It is suggested that these WIMP's should be captured and accumulated in the Sun core and then annihilate with their anti-particles producing high energy neutrinos($\geqq$ 1 GeV). A search is made for high energy neutrinos from the Sun, based on the 2 different data samples, 342 fully-contained neutrino events(2.82 kton center dot exposure) and 120 neutrino-induced upward-going muons(165.3 m/sup 2/ center dot yr exposure) recorded by the KAMIOKANDE detector. No significant excess signal of high energy neutrinos has been observed from the direction of the Sun, which sets mass limits on some of the WIMP's as a dark matter candidate.

23001 (KEK-PR—88-1, pp 120-127) **Proposal of an experiment to search for cosmic axions with microwave single photon counting using Rydberg atoms.** Fukuda, Yukio; Matsuki, Seishi. (Kyoto Univ. (Japan). Dept. of Physics). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780073/JAW. (CONF-8802136—).

From 2. workshop on elementary-particle picture of the universe; Tsukuba, Japan (4 Feb 1988).

A microwave single photon counting method with use of Rydberg atoms is proposed to search for cosmic axions. Even at very low temperatures below 1 K, this detection method would show a noise temperature nearly equal to the theoretical limit corresponding to the thermal radiation of the microwave components. By using this method, much improved results are expected in the test of the theoretical predictions about cosmic axions.

23002 (KEK-PR—88-1, pp 142-149) **Balloon-borne experiment for anti-proton and anti-matter.** Yoshida, T.; Anraku, K.; Imori, M. and others. (Tokyo Univ. (Japan)). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780073/JAW. (CONF-8802136—).

From 2. workshop on elementary-particle picture of the universe; Tsukuba, Japan (4 Feb 1988).

We are preparing a series of balloon-borne experiments to search for anti-protons and anti-matter of cosmic origin. The model thin solenoid for the ASTROMAG project will be equipped by a cylindrical jet chamber resulting to a large solid angle of 1 m/sup 2/sr. Anti-heliums will then be searched to a flux level of 10/sup -8/ relative to the helium. Simultaneously we can perform a very sensitive search of GeV γ-rays from point-sources. The energy spectra of the positrons and of various isotopes can be measured over a wide energy range. We are in the final stage of the design. The construction of the detector will start in July 1988. A prototype detector will be launched from Sanriku in June 1988.

23003 (KEK-PR—88-1, pp 150-162) **Search for /sup 8/B solar neutrinos at KAMIOKANDE-II.** Hirata, K.S.; Kajita, T.; Koshiba, M. and others. (Tokyo Univ. (Japan). Faculty of Science). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780073/JAW. (CONF-8802136—).

From 2. workshop on elementary-particle picture of the universe; Tsukuba, Japan (4 Feb 1988).

A search for /sup 8/B solar neutrinos in the KAMIOKANDE-II detector is presented. A flux upper limit of 3.6 x 10/sup 6/ ν/sub e//cm/sup 2//sec on /sup 8/B solar neutrino is obtained at 90 % confidence level, based on 330 days of detector live time. This flux upper limit is lower than the expectation from the standard solar model, (5.8 +- 2.1) x 10/sup 6//cm/sup 2//sec (effective 3 σ error). The KAMIOKANDE-II reconfirms the deficiency of the expected /sup 8/B solar neutrino flux (known as the solar neutrino problem).

23004 (KEK-PR—88-1, pp 181-196) **Proposal for a large area water Cerenkov detector dedicated to ν and γ-ray astrophysics (LENA).** Sasaki, M.; Kawagoe, K.; Kifune, T.; Kakimoto, F.; Koshiba, M.; Orito, S.; Tesima, J. (Tokyo Univ. (Japan). Dept. of Physics). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780073/JAW. (CONF-8802136—).

From 2. workshop on elementary-particle picture of the universe; Tsukuba, Japan (4 Feb 1988).

LENA(Lake Experiment on Neutrino Astronomy) is an omni-purpose experiment to open new windows of neutrino astronomy, gamma-ray astronomy and particle physics with a large (10/sup 4/ m/sup 2/) water Cerenkov detector. The proposed detector can decide the direction of a neutrino or gamma-ray point source with the accuracy of about 1 degree, and can explore exciting phenomena in elementary particle physics : neutrino oscillation, photino-induced high energy neutrino from the Sun, etc.

23005 (KURRI-TR—308, pp 24-29) **Preliminary report on the development of a CaF/sub 2/-window for a satellite-borne gas scintillation proportional counter.** Torii, Tatsuharu. (Nagoya Univ. (Japan). Faculty of Science). Sep 1988. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780083/JAW. (CONF-8709418—).

From 8. symposium on the development of advanced technology for scientific research; Kumatori, Japan (24 Sep 1987).

We are trying to acquire the technique of producing a window which is the neces sary part of a satellite-borne gas scintillation proportinal counter (GSPC, X-ray detector). One of the substantial points to produce the window is the selection of gasket. Therefore, we measured compressibility and sealing behavior of six kinds of metal gaskets experimentally, and selected a suitable one. By using the metal gasket, a CaF/sub 2/ plate, and two flanges of aluminum alloy, we have made a CaF/sub 2/-window. The window was tighten up to the temperature of 215 deg C under ultra high vacuum.

23006 **(LA-UR—88-3865) Ultra-sensitive x-ray sensors give improved contrast sensitivity.** Stupin, D.M. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 10p. (CONF-890478—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003581/JAW.

From 12. world conference on non-destructive testing; Amsterdam, Netherlands (23 Apr 1989).

Low-light-level cameras used with phosphors detect very small contrast differences and very small features in x-ray images. I used (1) a silicon-intensifier-tube (SIT) television camera coupled by a fiber optic to a phosphor screen and (2) an integrating CCD camera focused on a phosphor to detect a 0.1% contrast difference and 2-micrometer-diameter wires in a digital image. Flannery, et al., and Kinney, et al., reported spatial resolution as small as 1 micrometer in computer x-ray tomography (CAT scans) using synchrotron x-ray sources and CCD cameras. I thought that these cameras could be used with industrial x-ray sources with microfocal spot sizes to produce x-ray images with spatial resolution as small as 1 micrometer and contrast sensitivity as small as 0.01%. Hence, near-real time x-ray inspection system could be made that have the resolution of x-ray film and 20 times better contrast sensitivity. As a proof of principle experiment, I used an x-ray camera composed of an x-ray phosphor deposited on a fiber optic that is coupled to a night vision camera (SIT). Using a digital subtraction technique and an 8-bit frame grabber, this camera detected wires as small as 2 micrometers in diameter and x-ray attenuations as small as 0.27%. Verhoeven reported 0.14% for a free-standing foil without a substrate. However, some CCD cameras have 64 times more levels of digitization than the frame grabber and can integrate images for as long as 30 minutes before the images are digitized. Hence, I predicted that the CCD camera would also detect wires 2 micrometers in diameter and contrast differences as small as 0.02%, ten times better than the SIT and 20 better than film. Unfortunately, my preliminary experiments with CCD camera duplicate, but do not improve upon, the performance of the SIT. 8 refs., 4 figs.

23007 **(LA-UR—89-420) Use of proportional tubes in a muon polarimeter.** Kenney, C.J.; Eckhause, M.; Ginkel, J.F.; Guss, P.P.; Kane, J.R.; Vulcan, W.F.; Welsh, R.E.; Whyley, R.J.; Bilskie, J.; Hart, G.W. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-881103—56). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007743/JAW.

From IEEE nuclear science symposium; Orlando, FL, USA (9 Nov 1988).

A prototype muon polarimeter was built to study the feasibility of measuring the positive muon polarization in the decay K/sub L/ $\rightarrow \mu^+ \mu$/sup {minus}/. The system consisted of alternating layers of extruded aluminum gas proportional tubes and polarization-retaining absorber plates of either aluminum or marble. Longitudinally polarized positive muons from the Stopped Muon Channel at the Clinton P. Anderson Meson Physics Facility (LAMPF) were stopped in the absorber plates where they precessed in a field of 60 gauss. Decay times were recorded in 100 ns first-in-first-out memories for all wires hit during a 12.8 μs period centered about the muon stop trigger. The performance of the system was studied for different beam rates and absorber thicknesses. The value of imposing time and spacial cuts on track data to enhance the precession signal was also investigated. 7 refs., 4 figs., 1 tab.

23008 **(LBL—25223) A variable temperature cryostat that produces in situ clean-up germanium detector surfaces.** Pehl, R.H.; Madden, N.W.; Malone, D.F.; Cork, C.P.; Landis, D.A.; Xing, J.S.; Friesel, D.L. (Lawrence Berkeley Lab., CA (USA)). Nov 1988. Contract AC03-76SF00098. 10p. (CONF-881103—57). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008174/JAW.

From IEEE nuclear science symposium; Orlando, FL, USA (9 Nov 1988).

Variable temperature cryostats that can maintain germanium detectors at temperatures from 82 K to about 400 K while the thermal shield surrounding the detectors remains much colder when the detectors are warmed have been developed. Cryostats such as these offer the possibility of cryopumping material from the surface of detectors to the colder thermal shield. The diode characteristics of several detectors have shown very significant improvement following thermal cycles up to about 150 K in these cryostats. Important applications for cryostats having this attribute are many. 4 figs.

23009 **(LBL—26075) Electromagnetic detectors.** Lambertson, G.R. (Lawrence Berkeley Lab., CA (USA)). Jan 1989. Contract AC03-76SF00098. 25p. (CONF-8810332—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008151/JAW.

From Joint US-CERN school on particle accelerators; Isola di Capri, Italy (20 Oct 1988).

This paper discusses the design and physics of some electromagnetic detectors. 19 refs., 16 figs. (LSP)

23010 **(NIKHEF-H—88-4) Experimental study of uranium plastic scintillator calorimeters.** D'Agostini, G.; Bamberger, A.; Barreiro, F. (Rome Univ. (Italy); Freiburg Univ. (Germany, F.R.); Universidad Autonoma de Madrid (Spain)). (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Apr 1988. 25p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706105/JAW.

As preparation for the ZEUS high resolution calorimeter, sampling calorimeters made from 3.2 mm plates of depleted uranium read out by plastic scintillator of 3 mm and 5 mm thickness have been built. The response of hadrons, electrons and muons has been measured in the energy range between 3 and 100 GeV. In agreement with predictions, the relative response of electrons and hadrons as well as the hadronic energy resolution depend strongly on the thickness of the plastic scintillator. For 3.2 mm depleted uranium and 3 mm thick scintillator we observe over the full energy range equal response for electrons and hadrons; a hadronic energy resolution of $34.5\%/\sqrt{E[GeV]}$ is obtained. Results are given for the spatial resolution for electrons and hadrons. Finally results from a lead scintillator calorimeter built as a prestudy before uranium plates were available are reported. 12 refs.; 9 figs.; 6 tabs.

23011 **(ORNL/TM—10954) Prospects for and tests of hadron calorimetry with silicon.** Brau, J.E.; Gabriel, T.A.; Rancoita, P.G. (Oak Ridge National Lab., TN (USA)). Mar 1989. Contract AC05-84OR21400. 46p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009684/JAW.

Hadron calorimetry with silicon may provide crucial capabilities in experiments at the high luminosity, high energy colliders of the future, particularly due to silicon's fast intrinsic speed and absolute calibration. The important underlying processes of our understanding of hadron calorimeters are reviewed to set the framework for the presentation of recent calculations of the expected performance of silicon detector based hadron calorimeters. Such devices employing uranium are expected to achieve the compensation condition (that is, the ratio of the most probable electron signal to hadron signal (e/h) is ~1.0) based on the understanding that has been derived from the uranium-liquid argon and uranium-plastic scintillator systems. In fact, even lead-silicon calorimeters are found to achieve the attractive value for the e/h ratio of 1.16 at 10 GeV. An experimental test of these predictions is underway at CERN by the SICAPO Collaboration. 64 refs., 19 figs.

23012 **(SAND—89-0216) Primary Standards Laboratory report: Second half 1988.** (Sandia National Labs., Albuquerque, NM (USA)). Mar 1989. Contract AC04-76DP00789. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009005/JAW.

Sandia National Laboratories operates the Primary Standards Laboratory (PSL) for the Department of Energy, Albuquerque Operations Office (DOE/AL). This report summarizes metrology activities that received emphasis in the second half of 1988 and provides information pertinent to the operation of the DOE/AL system-wide Standards and Calibration Program. 8 refs.

23013 **(SLAC-PUB—4860) Wire chamber requirements and tracking simulation studies for tracking systems at the superconducting super collider.** Hanson, G.G.; Niczyporuk, B.B.; Palounek, A.P.T. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1989. Contract AC03-76SF00515. 15p. (CONF-890231—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008985/JAW.

From 5. international wire chamber conference; Vienna, Austria (13 Feb 1989).

Limitations placed on wire chambers by radiation damage and rate requirements in the SSC environment are reviewed. Possible conceptual designs for wire chamber tracking systems which meet these requirements are discussed. Computer simulation studies of tracking in such systems are presented. Simulations of events from interesting physics at the SSC, including hits from minimum bias background events, are examined. Results of some preliminary pattern recognition studies are given. Such computer simulation studies are necessary to determine the feasibility of wire chamber tracking systems for complex events in a high-rate environment such as the SSC. 11 refs., 9 figs., 1 tab.

23014 **Design for a practical laboratory detector for solar axions.** van Bibber, K.; McIntyre, P.M.; Morris, D.E.; Raffelt, G.G. (Physics Department, Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review [Section] D: Particles and Fields;* **39**: No. 8, 2089-2099(15 Apr 1989).

We present a practical design for a detector sensitive to axions and other light particles with a two-photon interaction vertex. Such particles would be produced in the solar interior by Primakoff conversion of blackbody photons and could be detected by their reconversion into x rays (average energy about 4 keV) in a strong laboratory magnetic field. An existing large superconducting magnet would be suitable for this purpose. The transition rate is enhanced by filling the conversion region with a buffer gas (H_2 or He). This induces an effective photon mass (plasma frequency) which can be adjusted to equal the axion mass being searched for. Axion-photon conversion is then coherent throughout the detector volume for all axion energies. Axions with mass in the range 0.1 eVapprox. <m/sub a/approx. <5 eV can be detected using gas pressures of 0.1--300 atm. Axions with the standard coupling strength to photons would give counting rates of 10/sup -5/--10 sec/sup -1/ over this mass range. The search would definitively test one of the only two regions of axion parameters not excluded by astrophysical constraints.

23015 **Neutron-treated, ultrafast, photoconductor detectors.** Wang, C.L.; Pocha, M.D.; Morse, J.D.; Singh, M.S.; Davis, B.A. (Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94551). *Applied Physics Letters;* **54**: No. 15, 1451-1453(10 Apr 1989).

We have investigated homogeneous, photoconductive semiconductors as very fast radiation detectors. We irradiated GaAs, Cr-doped GaAs, and Fe-doped InP crystals with 14 MeV neutrons to produce lattice defects that act as fast recombination centers for electrons and holes. Using short-pulse lasers and 17 MeV linear-accelerator electrons and bremsstrahlung x rays, we measured the temporal response and sensitivity of these photoconductors as functions of fluence ranging from 10^{12} to 10^{16} neutrons/cm^2. The carrier lifetime and mobility decrease monotonically as the neutron fluence increases, resulting in faster detector response at the expense of sensitivity. A resolving time of less than 30 ps (full width at half maximum) was measured for the above photoconductors irradiated with {similar←to}10^{15} neutrons/cm^2.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

23016 **(CONF-890447—1) Load flow studies in the presence of magnetohydrodynamic electromagnetic pulse.** Kruse, V.J.; Rackliffe, G.B.; Barnes, P.R. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89001190/JAW.

From 11. IEEE/PES T&D meeting; New Orleans, LA, USA (2 Apr 1989).

Seconds after an high-altitude nuclear event the earth's surface experiences a very low frequency, quasi-DC magnetohydrodynamic electromagnetic fields (MHD-EMP). MHD-EMP fields impress quasi-DC currents on transmission and sub-transmission lines. These current magnitudes can exceed several times the transformer exciting current levels. Transformers and shunt reactors experience severe halfcycle saturation resulting in harmonics and increased VAR demand. This paper reviews the calculation of the quasi-DC currents, discusses the calculation of the increased VAR demand, and evaluates the effect of a simulated MHD-EMP event on a power system with stability and load flow analyses. 9 refs., 5 figs., 3 tabs.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 22005, 22331, 22501, 22649, 22667, 22713, 22828, 22829, 22942, 22944, 23008, 23012, 23042, 23210, 23211, 23786

23017 **(CONF-8904111—3) Approximation technique for determining gain and radiation pattern of the horn antenna.** Ewing, P.D. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006136/JAW.

From Southeastcon '89 conference and exhibition; Columbia, SC, USA (9 Apr 1989).

An approximation can be used to avoid the complex mathematics and computation methods for calculating the gain and radiation pattern of the electromagnetic horn antenna. Because of the curvature of the antenna wave front, calculations using conventional techniques typically involve solving the Fresnel integrals and using computer-aided numerical integration. With this model, linear approximations give a reasonable estimate of the gain and radiation pattern using simple trigonometric functions, allowing a hand calculator to replace the computer. The case of the E-plane horn antenna was used to evaluate this technique, applying selected criteria. Results showed that the gain approximation holds for an antenna flare angle of less than 10{degree} for typical antenna dimensions, and the E field radiation pattern approximation holds until the antenna's phase error approaches 60{degree}, both within typi-

cal design parameters. This technique is a useful engineering tool. 4 refs., 11 figs.

23018 (JINR—N-3-29-88, pp 33-40) **Investigation of VASSILISSA kinematic separator characteristics.** Andreev, A.N.; Bogdanov, D.D.; Gorshkov, V.A.; Eremin, A.V.; Kabachenko, A.P.; Orlova, O.A.; Ter-Akop'yan, G.M.; Chepygin, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780080/JAW.

In JINR rapid communications. Collection.

The main parameters of the electrostatic separator for complete-fusion reaction products VASSILISSA were investigated. An efficiency of 4%, 14% and 20% was obtained for reactions with Ne, P and Ar ions, respectively. The separation factors for scattered Ar, P and Ne ions were obtained to be equal to 10/sup 10/, 10/sup 11/ and 10/sup 12/. The separation factor for primary beam ions is equal to 10/sup 15/-10/sup 17/. Previous experiments are carried out in order to determine a possibility of the experiments to sunthesize new elements. 6 refs.; 3 figs.; 1 tab.

23019 **(KURRI-TR—308) Development of advanced technology for scientific research.** Okamoto, Sunao (ed.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Sep 1988. Vp. (CONF-8709418—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89780083/JAW.

From 8. symposium on the development of advanced technology for scientific research; Kumatori, Japan (24 Sep 1987).

Individual papers are processed separately for the data base. (DLC)

23020 **(LA-UR—89-479) ALEXIS [Array of Low-Energy X-Ray Imaging Sensors]: A narrow-band survey/monitor of the ultrasoft x-ray sky.** Priedhorsky, W.C.; Bloch, J.J.; Cordova, F.; Smith, B.W.; Ulibarri, M.; Chavez, J.; Evans, E.; Seigmund, O.H.W.; Marshall, H.; Vallerga, J. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 29p. (CONF-890189—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007980/JAW.

From Berkeley colloquium on extreme ultraviolet astronomy; Berkeley, CA, USA (19 Jan 1989).

Los Alamos and Sandia National Laboratories are building an ultrasoft X-ray monitor experiment. This experiment, called ALEXIS (Array of Low-Energy X-Ray Imaging Sensors), consists of six compact normal-incidence telescopes. ALEXIS will operate in the range 70--110 eV. The ultrasoft X-ray/EUV band is nearly uncharted territory for astrophysics. ALEXIS, with its wide fields-of-view and well-defined wavelength bands, will complement the upcoming NASA Extreme Ultraviolet Explorer and ROSAT EUV Wide Field Camera, which are sensitive broad-band survey experiments. The program objectives of ALEXIS are to (1) demonstrate the feasibility of a wide field-of-view, normal incidence ultrasoft X-ray telescope system and (2) to determine ultrasoft X-ray backgrounds in the space environment. As a dividend, ALEXIS will pursue the following scientific objectives: (1) to map the diffuse background, with unprecedented angular resolution, in several emission-line bands, (2) to perform a narrow-band survey of point sources, (3) to search for transient phenomena in the ultrasoft X-ray band, and (4) to provide synoptic monitoring of variable ultrasoft X-ray sources such as cataclysmic variables and flare stars. ALEXIS is designed to be flown on a small autonomous payload carrier (a minisat) that could be launched from any expendable launch vehicle. The experiment weighs 100 pounds, draws 40 watts, and produces 10 kbps of data. It can be flown in any low earth orbit. Onboard data storage allows operation and tracking from a single ground station at Los Alamos. 57 refs., 12 figs.

23021 **(LA-UR—89-850) Optical trapping, cell manipulation and robotics.** Buican, T.N.; Neagley, D.L.; Morrison, W.C.; Upham, B.D. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 9p. (CONF-890158—2). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009393/JAW.

From SPIE symposium on medical applications of lasers and optics; Los Angeles, CA, USA (15 Jan 1989).

A new type of analytical and preparative cytometric instrument was developed. The instrument combines image analysis and machine vision with single cell and chromosome manipulation by means of optical trapping. A proof-of-principle instrument, OCAM, has the ability to locate and analyze biological particles inside an enclosed manipulation chamber, as well as the ability to move and position particles according to preprogrammed protocols. Preliminary results and potential biological applications of such a microrobot are discussed. 12 refs., 8 figs.

23022 **(LA-UR—89-973) Rf phase measurement at PHERMEX [Pulsed High Energy Radiographic Machine Emitting X-Rays] using time-to-digital converters.** Watson, S.A.; Jennings, G.R.; Moir, D.C. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 3p. (CONF-890335—16). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009268/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

Recent advances in time-to-digital converters (TDCs) have made 50-MHz rf phase measurement possible without the use of double-balanced mixers. These advances allow zero crossing discriminators to be used in conjunction with fast CAMAC TDCs to make amplitude-independent phase measurements. This method uses a time interval proportional to the phase angle, thus eliminating any of the calculations and calibration required with double-balanced mixers. 4 refs., 1 fig., 1 tab.

23023 **(LBL—26319) Atomic imaging and microanalysis of ceramics.** Thomas, G.; Ramesh, R. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 35p. (CONF-8810195—6). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008172/JAW.

From 41. Pacific coast regional meet of American Ceramic Society; San Francisco, CA, USA (24 Oct 1988).

This paper is a short review of electron microscopy techniques, as applied to modern ceramics. Examples: representative of the significance of modern electron microscopy, methods of atomic resolution imaging, diffraction and spectroscopy in the task of characterising, and understanding typical ceramic materials are given. (JL)

23024 **(LBL-PUB—475-Rev.) National center for electron microscopy: User's guide revised.** (Lawrence Berkeley Lab., CA (USA)). Mar 1989. Contract AC03-76SF00098. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009309/JAW.

The National Center for Electron Microscopy (NCEM) in the Materials and Chemical Sciences Division of the Lawrence Berkeley Laboratory is a high voltage electron microscope facility for ultra-high resolution or dynamic in-situ studies. It is supported by the Director, Office of Energy Research, Office of Basic Energy Sciences, Materials Science Division, and US Department of Energy under. This user's guide describes several microscopes at the facility. 6 figs., 8 tabs.

23025 **(NCRP—99) Quality assurance for diagnostic imaging equipment: Recommendations of the National Council on Radiation Protection and Measurements.** (National Council on Radiation Protection and Measurements, Bethesda, MD (USA)). 30 Dec 1988. 264p. National Council on Radiation Protection and Measurements, 7910 Woodmont Avenue, Suite 800, Bethesda, MD 20814 $18.00.

The purposes of this report are to encourage the establishment of practical and comprehensive quality assurance programs in medical imaging facilities and to provide guidance for developing and implementing such programs. The report is designed for all health care professionals with responsibility for planning and operation of any aspect of a quality assurance program; however, it is intended primarily for practicing radiologists, other physicians and medical physicists. 170 refs.

23026 **(NRC/ME—8711) Evaluation of the EXAC mass flowmeter.** MacLeod, J.D. (National Research Council of Canada, Ottawa, Ontario. Div. of Mechanical Engineering). 1987. 22p. (MICROLOG—88-04476). National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, Canada K1A 0R6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report describes the work performed to evaluate a mass flowmeter with regards to its accuracy and suitability in the engine test cell environment. The device was installed in series with existing turbine meters in the fuel delivery system of a gas turbine. Evaluation procedures included observations on the installation and operation of the unit in general, and more specifically, a comparison of the flow measurement with those of the turbine meters. In addition, an attempt was made to interface a computer with the flowmeter to allow for automated data acquisition. Results show that when operating properly, agreement between the flowmeter and the turbine flowmeters was within 1%. Interfacing the meter with a computer was extremely difficult, and produced unpredictable results. The flow sensor is relatively easy to install and did not require any special installation precautions. Installation of the meter in a test cell was not recommended at this time, due to the unreliability of the device on a day-to-day basis. 3 refs., 8 figs., 3 tabs.

23027 **(SAND—88-2720C) Autofocus of SAR imagery degraded by ionospheric-induced phase errors.** Jakowatz, C.V. Jr.; Eichel, P.H.; Ghiglia, D.C. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 7p. (CONF-890374—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008278/JAW.

From SPIE technical symposium on aerospace sensing; Orlando, FL, USA (27 Mar 1989).

It has been suggested that synthetic aperture radar (SAR) images obtained from platforms such as SEASAT are subject to potential degradation by ionospheric-induced phase errors. This premise is based upon data from various satellite experiments that indicate large levels of phase scintillation in auroral zone data. Current models for phase errors induced by the ionosphere suggest that the phase error power spectrum is power law. This implies that the resulting phase errors contain significant components up to the Nyquist limit. Traditional sub-aperture based autofocus techniques, designed to correct uncompensated platform motion errors, are inadequate due to their inability to estimate higher order error terms. A new non-parametric phase error correction scheme developed at Sandia National Laboratories, however, has been demonstrated to remove phase errors of arbitrary structure. Consequently, our new algorithm is a viable candidate for correcting ionospheric phase errors. In this paper we show examples of SAR images degraded by simulated ionospheric phase errors. These images demonstrate that such errors cause smearing with complicated sidelobe structure. Restoration of these images via the new algorithm illustrates its superiority to classical sub-aperture based autofocus techniques.

23028 **(UCRL—98426) Wavelength streak camera.** McConaghy, C.; Koo, J. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 5p. (CONF-8809105—13). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008612/JAW.

From SPIE O-E Laser: international symposium and exhibition on fiber optics, optoelectronics and laser applications; Boston, MA, USA (6 Sep 1988).

We have demonstrated the recording of 8 Ghz electrical signals by optically encoding time into wavelength and deflecting, by means of a diffraction grating, the optical signal across a readout array. The experiments were performed at 820 nm and show promise for circumventing the material dispersion in fibers at this wavelength to allow propagation of high bandwidth microwave signals (up to 10 Ghz) over 1 km distances. 1 ref., 1 fig.

23029 **(UCRL—99288) The role of sensors in the accuracy of machine tools.** McClure, E.R. (Lawrence Livermore National Lab., CA (USA)). 26 Jul 1988. Contract W-7405-ENG-48. 19p. (CONF-8810323—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008119/JAW.

From 3. international machine tool engineers conference (IMEC); Tokyo, Japan (31 Oct 1988).

Accuracy of machine tools is impossible without the assistance of sensors. The original manufacturers employed human senses, especially touch and sight, to enable the human brain to control manufacturing processes. Gradually, manufacturers found artificial means to overcome the limitations of human senses. More recently, manufacturers began to employ artificial means to overcome the limitations of the human brain to effect control of manufacturing processes. The resultant array of sensors and computers, coupled with artificial means to overcome the limitations of human skeletons and muscles is embodied in modern machine tools. The evolution continues, resulting in increasing human capacity to create and replicate products. Machine tools are used to make products, are assembled with products and are products themselves. Consequently, sensors play a role in both the manufacture and the use of machine tools. In order to fully manage the design, manufacture and operation of precise and accurate machine tools, engineers must examine and understand the nature of sources of errors and imperfections. Many errors are not directly measurable, e.g., thermal effects. Consequently, control of such errors requires that engineers base the selection and use of sensors on an understanding of the underlying cause and effect relationship. 15 refs., 4 figs.

23030 **(UCRL—100083) Characterization of multilayer coated concave diffraction gratings in the extreme ultraviolet.** Bixler, J.; Barbee, T. Jr.; Dietrich, D. (Lawrence Livermore National Lab., CA (USA)). Feb 1989. Contract W-7405-ENG-48. 13p. (CONF-890189—5). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008831/JAW.

From Berkeley colloquium on extreme ultraviolet astronomy; Berkeley, CA, USA (19 Jan 1989).

We describe here our work to date on characterizing two multilayer coated concave diffraction gratings, one conventionally ruled, the other holographically ruled. We have obtained photographic spectra with both gratings which indicate good resolution properties and promising efficiencies. 5 refs., 3 figs.

23031 **(Y—2402) Machine reference mirror inspection by optical Fabry-Perot cavity testing.** Yoder, R.C.; Goodwin, W.L.; Werner, G.K. (Oak Ridge Y-12 Plant, TN (USA)). Jan 1989. Contract AC05-84OS21400. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009635/JAW.

The purpose of this endeavor was to design and validate an optical technique for measuring in situ the included dihedral angle of a pair of reference mirrors of a dual-YZ machine to a requested accuracy of 0.1 arc second. A whole-field optical test was investigated for application to this task; and optics were procured, characterized, and set up in a mockup machine test configuration. Data presented here were analyzed to validate the technique, and recommendations for its implementation are given. 10 figs., 3 tabs.

23032 **Radiation to coherent light converter.** Wang, C.L.; Bar-Chaim, N.; Lau, K.Y.; Marshall, B.R.; Thomas, M.C.; Zagarino, P.A. (University of California, Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94551). *Applied Physics Letters;* **54**: No. 16, 1498-1500(17 Apr 1989).

We have developed a radiation to coherent light converter with a monolithically integrated semiconductor chip that consists of a chromium-doped GaAs photoconductor detector and a GaAlAs laser diode. When irradiated, the electric pulse generated by the photoconductor detector modulates the laser diode, which has been biased above the lasing threshold, thus converting a radiation pulse to an electric pulse and then to a light pulse. The laser pulse is then transmitted to a fast recorder through a high bandwidth optical fiber. In the absence of a single-step x-ray pumped laser, our converter appears to be the first integrated device that can efficiently convert x-ray flux into coherent light. This device has been tested successfully with the 50 ps electron beams of 17 MeV linear accelerator and with 50 ns x-ray pulses from a Z-pinch plasma source.

23033 **Bragg holographic structures for XUV applications: a new approach.** Jannson, T.; Savant, G.; Qiao, Y. (Physical Optics Corporation, 2545 W. 237th Street, Torrance, California 90505). *Optics Letters;* **14**: No. 7, 344-346(1 Apr 1989).

We report a new technique for producing high-efficiency XUV Bragg (volume) holographic optical elements by recording interference patterns in a photosensitive coating in either the visible or XUV region. Theoretical calculations and analysis of experimental results have successfully demonstrated the significance of this new fabrication methodology for XUV holographic optical elements, with over 25% diffraction efficiency achieved. In addition, volume holographic optics offer high flexibility in conventional and nonconventional operations, high laser-damage threshold and temperature stability, low surface roughness, and cost effectiveness in mass production.

23034 **Compact portable diffraction moire interferometer.** Deason, V.A.; Ward, M.B. (to Dept. of Energy). US Patent Application 7-197,235. 23 May 1988. 29p. Contract AC07-76ID01570. DE89009651 NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009651/JAW.

A compact and portable moire interferometer used to determine surface deformations of an object. The improved interferometer is comprised of a laser beam, optical and fiber optics devices coupling the beam to one or more evanescent wave splitters, and collimating lenses directing the split beam at one or more specimen gratings. Observations means including film and video cameras may be used to view and record the resultant fringe patterns. 7 figs.

23035 **Acoustic wave device using plate modes with surface-parallel displacement.** Martin, S.J.; Ricco, A.J. (to US Dept. of Energy). US Patent Application 7,187,776. 29 Apr 1988. 20p. Contract AC04-76DP00789. DE89009719 NTIS, PC A03 - OSTI. Order Number DE89009719/JAW.

Solid-state acoustic sensors for monitoring conditions at a surface immersed in a liquid and for monitoring concentrations of species in a liquid and for monitoring electrical properties of a liquid are formed by placing interdigital input and output transducers on a piezoelectric substrate and propagating acoustic plate modes therebetween. The deposition or removal of material on or from, respectively, a thin film in contact with the surface, or changes in the mechanical properties of a thin film in contact with the surface, or changes in the electrical characteristics of the solution, create perturbations in the velocity and attenuation of the acoustic plate modes as a function of these properties or changes in them. 6 figs.

23036 **Low temperature cryoprobe.** Sungaila, Z.F. (to Dept. of Energy). US Patent Application 7-180,502. 12 Apr 1988. 14p. Contract W-31109-ENG-38. DE89009595 NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009595/JAW.

A portable, hand held probe usable within a small confine to produce a point source of nitrogen or helium at a relatively constant temperatures of 77 degrees Kelvin, is discussed. 3 figs.

4404 Well Logging Instrumentation

REFER ALSO TO CITATION(S) 21654, 21736

23037 **(SAND—87-2443C) Finite element analysis of a darcy velocimeter in a variably saturated soil.** Bixler, N.E.; Carrigan, C.R. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 7p. (CONF-890479—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003566/JAW.

From 7. international conference on finite element methods in flow problems; Huntsville, AL, USA (3 Apr 1989).

A new device, the Darcy velocimeter, is analyzed by the finite element method. The model is of two-phase flow and heat transport in a porous medium. Both laboratory-and field-scale experiments are simulated. The results show that the device should readily detect groundwater fluxes in the 10 to 100 m/yr range.

23038 **Method for in-situ restoration of platinum resistance thermometer calibration.** Carroll, R.M. (to Dept. of Energy, Washington, DC). US Patent 4,795,884. 3 Jan 1989. Filed date 23 Oct 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method is described for the in situ restoration of a platinum resistance thermometer, which has become decalibrated due to oxide surface film formation and/or strain-related damage, to a stress-free calibration condition wherein the thermometer includes a platinum resistor sensing element whose resistance varies with the temperature of the element in accordance with a known relationship. The method consists of: passing a controlled dc current through the platinum resistor sensing element, the current having a magnitude sufficient to raise the temperature of the element to its oxide decomposition and annealing temperature. The current is maintained for a heating period sufficient to restore the element to an oxide free surface and stress-free calibration condition.

45 EXPLOSIONS AND EXPLOSIVES

23039 **(MLM—3579) Mound's new Explosive Component Test Facility.** Esposito, D.J. (EG and G Mound Applied Technologies, Miamisburg, OH (USA)). 10 Mar 1989. Contract AC04-88DP43495. 19p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008960/JAW.

Unique to the Nuclear Weapons Complex, the Explosive Component Test Facility (ECTF) is a five year, $21.3 million expansion and modernization of the Test Fire area. Designed to enhance the operational flexibility of Mound's destructive testing capabilities, the ECTF incorporates new calibration techniques, improved safety interlock systems, state-of-the-art data acquisition equipment, test system hardware and software interchangeability, and real-time statistical process control. 4 refs., 11 figs., 1 tab.

4501 Chemical

23040 **(LA-UR—88-3902) Diamonds in the chemical products of detonation.** Greiner, N.R. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-890401—4). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003559/JAW.

From 197. national meeting of the American Chemical Society; Dallas, TX, USA (9 Apr 1989).

Diamonds have been found among the solid carbonaceous chemical products of high-explosive detonations. Explosives are fuel-oxidizer systems premixed on a molecular scale. This talk discusses some aspects of the chemical and hydrodynamic environment in which these diamonds form and some characteristics of the diamonds recovered. Diamonds have been recovered from detonations of composite explosives composed of trinitrotoluene (TNT) mixed with other powdered solid explosives, such as cyclo-trimethylenetrinitramine (RDX), triaminotrinitrobenzene (TATB), ammonium nitrate (AN), and nitroguanidine (NQ). The detonations were carried out in a 1.5-m^3 tank, usually filled with 1 atm of Ar gas. Other explosive composites and one-component explosives have also been investigated. The diamonds have been characterized by transmission electron microscopy, x-ray diffraction, and various chemical means. 8 refs., 3 figs.

23041 **Reverse slapper detonator.** Weingart, R.C. (to US Dept. of Energy). US Patent Application 7-186,527. 27 Apr 1988. 19p. Contract W-7405-ENG-48. DE89009594 NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009594/JAW.

A reverse slapper detonator, and methodology related thereto, are provided. The detonator is adapted to be driven by a pulse of electric power from an external source. A conductor is disposed along the top, side, and bottom surfaces of a sheetlike insulator. Part of the conductor comprises a bridge, and an aperture is positioned within the conductor, with the bridge and the aperture located on opposite sides of the insulator. A barrel and related explosive charge are positioned adjacent to and in alignment with the aperture, and the bridge is buttressed with a backing layer. When the electric power pulse vaporizes the bridge, a portion of the insulator

is propelled through the aperture and barrel, and against the explosive charge, thereby detonating it. 5 figs.

23042 **Measurement of dynamic pressure in inert and reactive solids by PVF/sub 2/ and manganin gauges.** Urtiew, P.A.; Erickson, L.M. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA (US)). pp v of Techniques and theory of stress measurements for shock wave applications. Stout, R.B.; Norwood, F.R.; Fourney, M.E. Houston, TX; Industrial Presentations Inc. (1987). (CONF-8706186—).

From ASME applied mechanics, bioengineering and fluid engineering conference; Cincinnati, OH, USA (14 Jun 1987).

Dynamic pressure measurements in solids subjected to excessive loading conditions have recently been enriched by the deployment of a small, new self-powered, polarization type gauge. The transducer, known as PVF/sub 2/ (polyvinylidene fluoride), is a thin polarized sheet of polymer plastic which contains its own source of energy and does nor require any external power supply. For high pressure work the manganin gauge is considered as the transducer of choice. However, even this gauge is undergoing constant modifications and improvements for better resolution and accuracy. Of particular interest to us is the high resolution which can be attained in the measurement of rapid pressure variation with time in high explosive materials during the pressure build-up as well as during the pressure release phase behind a fully developed detonation wave. Performance of PVF/sub 2/ and manganin gauges is discussed in detail showing both the pros and cons of each type as pertinent to the in situ pressure measurements. Potential values of PVF/sub 2/ gauges are indicated and compared to those of the standard manganin gauges.

4502 Nuclear

REFER ALSO TO CITATION(S) 23016, 23915

23043 **(CONF-870961—Vol.1) Fourth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.** Olsen, C.W.; Donohue, M.L.; Wander, S. (eds.). (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 483p. NTIS, PC A21/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008622/JAW.

From 4. symposium on containment of underground nuclear explosions; Colorado Springs, CO, USA (21 Sep 1987).

This is Volume 1 of two unclassified volumes of the Proceedings of the Fourth Symposium on Containment of Underground Nuclear Explosions. The symposium was a meeting of workers at all levels in the containment community. Papers on containment and related geological, geophysical, engineering, chemical, and computational topics are included. Individual projects are processed separately for the data bases.

23044 **(CONF-870961—Vol.2) Fourth symposium on containment of underground nuclear explosions: Proceedings: Volume 2.** Olsen, C.W.; Donohue, M.L.; Wander, S. (eds.). (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 488p. NTIS, PC A21/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009077/JAW.

From 4. symposium on containment of underground nuclear explosions; Colorado Springs, CO, USA (21 Sep 1987).

This is Volume 2 of two unclassified volumes of the Proceedings of the Fourth Symposium on Containment of Underground Nuclear Explosions. The symposium was a meeting of workers at all levels in the containment community. Papers on containment and related geological, geophysical, engineering, chemical, and computational topics are included. Individual projects are processed separately for the data bases.

23045 **(CONF-890447—2) Flashover vulnerability of transmission and distribution lines to high-altitude electromagnetic pulse (HEMP).** Kruse, V.J.; Liu, T.K.; Tesche, F.M.; Barnes, P.R. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89002329/JAW.

From 11. IEEE/PES T&D meeting; New Orleans, LA, USA (2 Apr 1989).

This paper estimates the vulnerability of transmission and distribution lines to flashover from the electromagnetic pulse generated by a nuclear detonation 400 kilometers above the earth. The analysis consists of first determining the cumulative probability of induced-voltage on three-phase lines, including shield and neutral conductors, for four operating voltages and then comparing these stresses to estimates of line insulation strength. 11 refs., 9 figs., 5 tabs.

23046 **(CONF-8904111—4) The induced current in parallel wires over an imperfect ground from an incident EMP.** Neff, H.P. Jr.; Reed, D.A. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 29p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007209/JAW.

From Southeastcon '89 conference and exhibition; Columbia, SC, USA (9 Apr 1989).

The current that is induced in infinitely long, finitely conducting, and parallel wires over a finitely conducting plane earth from an incident electromagnetic pulse is investigated. Frequency-domain expressions for this current are derived. Time-domain results are obtained for the case of two wires at the same height above the earth for several wire spacings and ground parameters. It was found that the maximum current was about 8 kA for grazing incidence (θ = 6{degree}) when the wire spacing is large, corresponding to the single wire case. When the wire spacing is small, the current approaches one-half the value above (4 kA) as it should. This suggest the use of multiple wires in a cage arrangement for reducing the induced current. 5 refs., 10 figs.

23047 **(DOE/DP/00539—059) Summary of accidental releases of radioactivity detected off the Nevada Test Site, 1963--1986.** Patzer, R.G.; Phillips, W.G.; Grossman, R.F.; Black, S.C.; Costa, C.F. (comps.). (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). Aug 1988. Contract AI08-86NV10522. 61p. (EPA—600/8-87/054). NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009134/JAW.

Of the more than 450 underground nuclear explosives tests conducted at the Nevada Test Site from August 1963 (signing of the Limited Test Ban Treaty) through the end of 1986, only 23 accidentally released radioactivity that was detectable beyond the boundary of the NTS. Of these 23, 4 were detectable off the NTS only by aircraft while the remainder were detectable by ground monitoring instruments. Since the Baneberry venting of December 1970, only two tests released radioactivity that was detectable off the NTS, and this was a seepage of radioactive noble gases. None of these releases from underground tests designed for complete containment caused exposure of the population living in the area that exceeded standards recommended by national and international radiation protection agencies. This report summarizes the releases from each of the tests, describes the monitoring that was conducted, and lists the location of the maximum exposure.

23048 **(DOE/EH—0076) Technical safety appraisal of buildings 9206 and 9212, Oak Ridge Y-12 plant.** (USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC). Mar 1989. 130p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008716/JAW.

This report covers the results of a Safety Performance Review of the Y-12 Plant conducted during the period July 25 through August 3, 1988. A Safety Performance Review is a follow-up to assess changes in performance since the 1986 Technical Safety Appraisal (TSA). This review is patterned after a TSA and covered the overall safety performance at Y-12, evaluating progress to date against standards of accepted practice. The review included coverage of actions taken in response to recommendations in the TSA conducted in July--August 1986. Remaining issues were identified through an assessment of safety program deficiencies and their root causes. For each of the 14 safety-related functional areas at the Y-12 Plant, results of this review are listed in Section V. These results include a discussion, conclusions, and any new safety concerns for each program. Appendix A contains a description of

the system for categorizing concerns, and the concerns are summarily tabulated in Appendix B for all programs. Appendix C describes the contractor's response and current status of each of the 59 recommendations contained in the 1986 TSA.

23049 **(LA—11524-MS) Transitional strategic defense architectures.** Canavan, G.H. (Los Alamos National Lab., NM (USA)). Mar 1989. Contract W-7405-ENG-36. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008312/JAW.

Transitional deployments permit the rational evolution of increasing capability in each defensive layer. Boost-phase and midcourse transitions are discussed; a key feature is the need for balance between deployment and development. 31 refs., 1 fig.

23050 **(SAND—89-0266C) Numerical method to predict projectile penetration.** Schoof, L.A.; Maestas, F.A.; Young, C.W. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 6p. (CONF-8904119—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007140/JAW.

From 4. annual symposium on interaction of non-nuclear munitions with structures; Panama City, FL, USA (17 Apr 1989).

The Simplified Analytical Model of Penetration with Lateral Loading (SAMPLL) computer code developed at Sandia National Laboratories has been modified to allow additional penetration capabilities. The new capabilities include the ability to model penetration by other than cylindrical penetrators (flares, tapers, and boattails) and the ability to calculate penetration/perforation of multiple layers of different materials. Additionally, updated soil and rock empirical equations have been added to the model. A broader range of problems can now be modeled more accurately with the modified SAMPLL. 7 refs., 6 figs.

23051 **(SAND—89-0404C) White paper: Experimental and computational studies of very high velocity impacts.** Trucano, T.G.; Asay, J.R. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 5p. (CONF-890272—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007643/JAW.

From The LTH-t quarterly review; Santa Barbara, CA, USA (14 Feb 1989).

The following research is proposed: (1) Perform four to six new time-resolved lethality experiments on cadmium at projectile velocities 7 km/s, greater than that of our previous work at 5.2 km/s. The increased velocity will substantially increase the mass percentage of vaporization. Through simulation of these experiments, computer codes can be validated for hypervelocity impact when vaporization occurs. (2) Perform an additional four to six 1-D lethality experiments on zinc. This material undergoes substantial vaporization under the experimental conditions, and would expand our knowledge about the sensitivity of KEW lethality to shock-induced vaporization. (3) Perform two to four ballistic impact experiments with the ballistics gun at Sandia to provide a full validation of computational capabilities used in simulating the 1-D experiments. These experiments would probe phenomenology that is similar to the 1-D experiments, but with multi-dimensional debris propagation. This will extend the confidence in computer modeling to conditions analagous to KEW lethality applications.

23052 **Environmental effects of nuclear war.** MacCracken, M.C. (Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **178**: No. 1, 1-18(15 Dec 1988). (CONF-8804202—).

From Nuclear arms technologies in the 1990's; Washington, DC, USA (16 Apr 1988).

Substantial environmental disruption will significantly add to the disastrous consequences caused by the direct thermal, blast, and radiological effects brought on by a major nuclear war. Local fallout could cover several per cent of the Northern Hemisphere with potentially lethal doses. Smoke from post-nuclear fires could darken the skies and induce temperature decreases of tens of degrees in continental interiors. Stratospheric ozone could be significantly reduced due to nitric oxide injections and smoke-induced circulation changes. The environmental effects spread the consequences of a nuclear war to the world population, adding to the potentially large disruptive effects a further reason to avoid such a catastrophe.

23053 **Space-based interceptor.** Cunningham, C.T. (Lawrence Livermore National Laboratory). *AIP (American Institute of Physics) Conference Proceedings;* **178**: No. 1, 261-289(15 Dec 1988). (CONF-8804202—).

From Nuclear arms technologies in the 1990's; Washington, DC, USA (16 Apr 1988).

We calculate the effectiveness and marginal cost-effectiveness of SBI defenses against a variety of possible Soviet threats. Defense effectiveness is expressed in terms of participation fraction, which depends on SBI flyout distance and threat basing, and in terms of the number of interceptors needed to accomplish a given mission. Optimal interceptor sizing favors large high velocity rockets. With such optimal design, the defense appears marginally cost-effective with a 50% kill criterion against current or responsively modified large liquid boosters, although not against more stressing threats. Survivability of direct attack is not assessed, although survivability enhancement options are briefly discussed.

23054 **Introduction to antisubmarine warfare technology.** Sakitt, M. (Physics Department, Brookhaven National Laboratory, Upton, New York, and The Center for International Security and Arms Control, Stanford University, Stanford, California). *AIP (American Institute of Physics) Conference Proceedings;* **178**: No. 1, 357-375(15 Dec 1988). (CONF-8804202—).

From Nuclear arms technologies in the 1990's; Washington, DC, USA (16 Apr 1988).

This paper is an introduction to the acoustical techniques that are used in strategic antisubmarine warfare. We discuss the signals that are emitted from submarines, how they propagated and how they are attenuated in the ocean. Background noise in both the deep oceans and in the ice-covered Arctic regions are described. The general problems of searching and detection are outlined with specific examples evaluated for the U.S. and Soviet ballistic missile submarines.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 23082

23055 **(DOE/CE/15184—T1) Field evaluation of fog dispersal tests at Elmira, NY: Final report.** Rogers, C.W.; Wattle, B.J.; Mack, E.J. (Energy Innovations, Inc., Friendswood, TX (USA)). Jun 1987. Contract FG01-85CE15184. 42p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006700/JAW.

Calspan Corp., under contract to Energy Innovations, Inc., assisted in tests of the EGD Fog Precipiation System at Elmira/Corning Regional Airport in New York during the summer/fall fog season of 1986 by conducting an independent, objective evaluation of the EGD System during these tests. Specifically, Calspan's role was to: Establish and maintain a network of ground-based visibility monitors and supporting meteorological instrumentation for measuring fog characteristics during EGD System tests at Elmira; provide weather forecasts of the potential for fog at Elmira during the summer-fall fog season; analyze visibility and surface wind velocity measurements to determine the efficacy of the EGD system in producing visibility improvement during dispersal tests; and provide a final independent summary report documenting experiment protocol and the results of Calspan's analyses. 2 refs., 12 figs., 6 tabs.

23056 **(GSF-BPT—7/88) Mass spectrometry of stratospheric ions, trace gases and precondensation nuclei using balloon-borne measuring probes. Final report.** Arnold, F.; Schlager, H. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1988. 100p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757383/JAW.

Ions and tracer gases in the stratosphere can be measured and the reactions of them among each other can be followed by means of chemical ionisation mass spectrometry (CIMS). At the end of 1977, the first balloon measuring flight of the Heidelberg ion mass spectrometry probe took place. Since then, 35 measuring flights in the stratosphere were carried out in total. The development of the balloon production technique (increase of the balloon volume, integration of valves) made it meanwhile possible to take ion measurements and tracer gas measurements in a height of between 42 and 13 km. The gained experiences led to essential improvements of the measuring probe and the measuring technique but also to new developments in the field of equipment as for example the balloon-borne CIMS flow reactor. The project was completed and supported by a large-scale laboratory programme. The report on hand first deals with the measuring method and the measuring probe as well as the execution of the experiment. Then the results are shown and a short prospect on the future development of instruments and new measurements is given.

23057 **(Juel—2239) Climate problem in relation to science and politics.** Sassin, W.; Jaeger, J.; Primio, J.C. di; Fischer, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Forschungsgruppe Wirtschaft, Energie, Investitionen). Oct 1988. 127p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88757385/JAW.

Carbon dioxide emissions resulting from the combustion of fossile fuels for energy and the global use of the biosphere for agriculture and forestry have led to a significant alteration in the chemical composition of the atmosphere of our planet. Other emissions, too, from industry, domestic households and traffic are contributing to a build-up in the atmosphere of those trace gases which influence the earth's radiation balance and thus the central motor for climate events. Limiting carbon dioxide emissions presents a fundamentally new task for the energy industry and energy technology, which are based mainly if not exclusively on the use of fossile energy. The present study tries to evaluate the probable necessary limitations for the future use of coal, petroleum and natural gas on the basis of the accumulated knowledge about the effect of greenhouse gases, and their order of magnitude, on the climate. Independently of the existing considerable uncertainties over the presence of greenhouse gases in the atmosphere and the extremely complex climatic consequences of an intervention in the radiation balance, it can be shown that a retention of previous emissions - and that means an unaltered use of present fossile energy technology - will most likely lead to more far-reaching climatic changes than those which occurred during the great climatic upheavals in the earth's earlier history. The examination covers structures and processes of the international political system, within which measures aiming to restrict the emissions of greenhouse gases and measures aiming at adaptation to unavoidable climatic changes must be conceived and carried out.

23058 **(LIS—77) Smog situation from January 14 to 22, 1987 in North-Rhine Westphalia and its causes.** Kuelske, S.; Beier, R.; Pfeffer, H.U. (Landesanstalt fuer Immissionsschutz des Landes Nordrhein-Westfalen, Essen (Germany, F.R.)). 1988. 105p. (In German). Landesanstalt fuer Immissionsschutz des Landes Nordrhein-Westfalen, Essen (Germany, F.R.).

The smog situation from January 14 to 22, 1987 which led to a preliminary smog alarm in smog area IV (Middle Rhine-area) and in smog area II (Middle Ruhr-area), is investigated in detail with respect to the spatial and time development of the pollution concentration. The effects of meteorological causes on the load situation in the smog areas and partly outside the smog areas are described. Special attention is paid to the long-range transport and to the transports between the smog areas.

23059 **(NP—9770299) Ozone research program. The German contribution to climate and atmospheric research.** (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 20 Dec 1988. 45p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770299/JAW.

This publication presents the ozone research program of the Federal Republic of Germany for the years 1989-1993. The state of the art of the research on the problem of ozone variability in the stratosphere is described, including the meteorological and chemical processes during the reduction of its concentration, which is observed from time to time especially over antarctic regions. Further research is needed and it is required to organize the national research at the various institutions and to coordinate it with international programs. The financial support which is planned for the different years, is presented.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 21611, 21612, 21951, 21980, 22330, 22333, 22386, 22668, 23058, 23059, 23071, 23078, 23084, 23227

23060 **(ANL/EES-TM—362) Estimated monthly emissions of sulfur dioxide, oxides of nitrogen, and volatile organic compounds for the 48 contiguous states, 1987.** Kohout, E.J.; Saricks, C.L.; Miller, D.J. (Argonne National Lab., IL (USA). Energy and Environmental Systems Div.). Nov 1988. Contract W-31109-ENG-38. 33p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008991/JAW.

This report presents monthly estimates of emissions of sulfur dioxide (SO_2), nitrogen oxides (NO/sub x/), and volatile organic compounds (VOCs) by sector, region, and state for 1987 and highlights recent trends. It updates two previous Argonne National Laboratory reports. Some background on the methodology used to estimate emissions in the Current month and State Emission Trends project is presented. This methodology, which has been used for all three reports and which was described in detail in the previous two reports, is called the Month and State (M/S) methodology. It employs two estimation algorithms, one for electric utilities and another for nonutility sources. 16 figs., 9 tabs.

23061 **(ANL/EES-TM—363) Preinvestigation evaluation of corrective measure technologies for the Badger Army Ammunition Plant.** Benioff, P.A.; Tsai, S.Y. (Argonne National Lab., IL (USA)). Feb 1989. Contract W-31109-ENG-38. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008328/JAW.

This report briefly describes and evaluates the suitability of corrective measure technologies for possible use at the solid waste management units (SWMUs) at the Badger Army Ammunition Plant (BAAP), near Baraboo, Wisconsin. Corrective measure technologies considered for contaminated soils include excavation plus on- or off-site disposal in landfills or by incineration, use of solidification or stabilization methods, and in-situ methods such as bioreclamation and chemical or physical methods. Technologies considered for treatment of contaminated groundwater include groundwater pumping followed by discharge or treatment by air stripping and use of subsurface barriers. 5 refs., 1 tab.

23062 **(ECN—89-022) Atmospheric deposition and conversion of ammonium to nitric acid on a historic building. A pilot study.** Keuken, M.P.; Bakker, F.P.; Moels, J.J.; Broersen, B.; Slanina, J. (Netherlands Energy Research Foundation, Petten). Feb 1989. 36p. Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Dry and wet deposition on a church tower at Schagen, Netherlands, was estimated by means of sampling with exposure panels. These panels contain several test stones and the runoff water was collected for each stone separately. The runoff samples were analyzed for: Cl/sup -/, NO/sub 3//sup -/, NH/sub 4//sup +/, SO/sub 4//sup 2-/, Na/sup +/, K/sup +/, Ca/sup 2+/ and Mg/sup 2+/. They were located at a height of 20 m on the west and east side of the tower during a pilot study of seven months.

The concentrations of gaseous HCl, HNO/sub 3/, NH/sub 3/, SO/sub 2/, and Cl/sup -/, NO/sub 3//sup -/, NH/sub 4//sup +/ and SO/sub 4//sup 2-/ containing aerosols in air were measured during this field experiment. Precipitation was sampled by means of bulk and wet-only samplers. It is concluded that: passive sampling by means of exposure panels and analysis of the runoff is a simple method to estimate the total deposition on a monument; of the acid-deposition-related air pollutants deposited on the church tower more than 80% are deposited by dry deposition; as a result of the increased turbulence around the church tower, acid dry deposition is increased by at least a factor of 10 compared to lower vegetation. The role of ammonium deposition was studied by means of a /sup 15/N enriched ammonium solution added to the surface of stone samples. An increase is observed in the ratio /sup 15/N//sup 14/N in nitrate extracted from the stones. This indicates nitrification of ammonium to nitric acid, which results in increased weathering of a monument by the deposition of ammonium. 6 figs., 32 refs., 4 tabs.

23063 (IEACR—14) Acidic deposition--ecological effects on surface waters. Harter, P. (IEA Coal Research, London (UK)). Jan 1989. 72p. IEA Coal Research, 14-15 Lower Grosvenor Place, London, SW1W 0EX, England.

The acidification of soft water aquatic ecosystems, with consequent damage to the flora and fauna, is considered in this report. The evidence that environmental effects are ocurring is examined to see if a trend of increasing acidification can be related to changes in atmospheric deposition of sulphates and nitrates. Possible causes of change are considered, to clarify the contributions of variations in human activities and natural factors. It is concluded that acidic deposition, originating partly from emissions of sulphur and nitrogen compounds arising from man-made sources including combustion of fossil fuels, is causing acidification of surface waters in some areas of Europe and North America. There is proof that acidification of surface waters (to less than pH 6) is deleterious to many of the organisms whose habitat it forms. Acidified surface waters in some of the impacted areas are showing signs of recovery, where emissions of sulphur and nitrogen compounds from human activities are decreasing. There is some evidence that reversibility of acidification has started to occur, in some instances, about a decade after emissions were reduced. 219 refs., 13 figs., 9 tabs.

23064 (NP—9770308) Experimental investigations of acid precipitations. Final report. (Bundesforschungsanstalt fuer Landwirtschaft, Braunschweig (Germany, F.R.)). [1985]. 26p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770308/JAW.

In 1982 a field experiment was started, which was aimed at investigating the effects of an increased absorption of acids on population, soil and infiltrating water of a forest ecosystem. The central test unit is a soil spray irrigation system in an old spruce stock, which was 75 years old at the beginning of the test. In addition to this, an irrigation system for spraying over the tops of young spruce stocks, which were about 12 years old, was set up. It served for studying the acidification effects in the area of the tops as well as the changed influences on metabolism in soil caused thereby. Acid spray irrigation was carried out with and without liming. This leads, in comparison to normal calculation, to an essentially increased material discharge of ammonium, potassium, magnesium, calcium and manganese. But no serious damages of the stock were caused during the experiment. In case of continuous acid deposition, however, an increased soil acidification and a reduction of the nutrient content in the needles is to be expected.

23065 (NP—9770310) Emissions of acidifying pollutants in the Federal Republic of Germany up to 2000. Teufel, D.; Bauer, P.; Lippolt, R.; Westermann, K. (Umwelt- und Prognose-Institut Heidelberg e.V. (UPI) (Germany, F.R.)). Oct 1987. 38p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770310/JAW.

The development of the emission of NO/sub x/ and SO/sub 2/ during the last four years was analysed and the emission to be expected up to the year 2000 was studied. The following aspects were taken into consideration in the calculation of the expected emission course: all measures taken and planned so far by the Federal Government, the realization of more extensive economic reasonable measures and the effective reduction of emission according to the demand of the German Bundestag for reducing the forest dying syndrome. Up to the year 1990, NO/sub x/ could be reduced with 11% four times as much and up to the year 2000 with 41% two and a half times as much as by the measures of the Federal Government. The annual SO/sub 2/ emission could also be reduced: from 1990 it could be less than 610,000 t and from the middle of the 90s it could be less than 450,000 t per year. The future emission from industry, public power and heating stations, traffic (speed limits, low-pollutant cars), households and small consumers would then be even less than half the amount of the emissions, which were expected on the basis of the measures taken and planned so far. (HWJ).

23066 (NP—9770311) Reductive flue gas desulfurization. Final report. Gestrich, W. (Technische Univ. Berlin (Germany, F.R.). Inst. fuer Technische Chemie). 27 May 1987. 16p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770311/JAW.

The desulfurization (removal of SO/sub 2/) of oxygen-free flue gases can take place in a two-stage process by addition of reducing gases (carbon monoxide, hydrogen, methane, town gas, partially burnt fuel oil); in the first stage, the reducing process to sulfur vapour and hydrogen sulfide takes place at the Co-Mo contact (or at one of the other investigated catalysts); in the second stage, a polyethylene glycol scrubbing process, the hydrogen sulfide reacts with the residual SO/sub 2/ to sulfur and this - as well as the sulfur vapour formed beforehand - is removed as individual heavy liquid phase. The reaction can be carried out in such a way that the secondary pollutant carbonyl sulfide (COS) remains under the detection limit of 50 ppm and thus can be regarded as innoxious. The flue gases, which normally contain up to 3-5% by volume of oxygen, cannot be treated in such a way because all known and analyzed catalysts either lose their effectiveness or the processes had to take place at uneconomically high temperatures and with a vast consumption of reducing agents. The analysis of a series of precious metal catalysts showed that the generally low oxygen content is sufficient for an oxidation to a large extent of the sulfur dioxide into a sulfuric acid, which can be easily removed from the flue gas. Therefore no addition of a reactant would be necessary. But such catalysts are very expensive and their service life had to be examined very closely.

23067 (PNL-SA—14833) Energy and future climate forcing. Edmonds, J.A.; Scott, M.J. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 16p. (CONF-870695—10). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008125/JAW.

From 80. annual meeting of the Air Pollution Control Association; New York, NY, USA (21 Jun 1987).

The "greenhouse" issue is a term used to refer to a physical phenomenon in which the presence of radiatively active gases in the atmosphere absorb infrared radiation escaping into space and thereby warm the surface of the earth. In the absence of greenhouse gases such as carbon dioxide (CO_2), water vapor (H_2O), ozone (O_3), methane (CH_4), and nitrous oxide (N_2O), the earth's average surface temperature would be approximately zero degrees Fahrenheit rather than the 60 degrees F. that we observe. The greenhouse issue is a matter of increasing public concern because of the growing body of evidence that human activities are systematically altering the composition of the atmosphere. In 1800 the concentration of CO_2 was 280 parts per million volume (ppMv) (within an uncertainty range of 260--285 ppMv). In 1984 the average annual concentration measured at the Mauna Loa observatory in Hawaii was 344 ppMv. The formulation of appropriate policy options to address the greenhouse issue depend on the accumulation of reliable information in four domains: emissions, atmospheric composition, climate, and consequences. The purpose of this paper is to discuss the current state of knowledge in the area of emissions. 30 refs., 1 fig., 5 tabs.

23068 (PNL-SA—15429) Energy and radiative precursor emissions. Edmonds, J.A.; Wuebbles, D.L.; Scott, M.J. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1987. Contract AC06-76RL01830. 20p. (CONF-871204—8). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008124/JAW.

From 8. Miami international conference on alternative energy sources; Miami Beach, FL, USA (14 Dec 1987).

The timing and magnitude of climatic change, the "greenhouse" issue, depends on both man-made emissions and natural processes. Energy production, transformation, end-use and conservation are associated with emissions of many of the key radiatively important gases (RIG's). While studies have already been conducted to examine the link between energy use and CO_2, the linkages between energy and other RIG's are not well understood. In addition, while scenarios of future atmospheric composition used in climate studies have included an explicit recognition of the role of the carbon cycle, they have not included explicit models for the effects of atmospheric chemistry. Crude calculations are presented to examine the potential uncertainty with regard to radiative forcing which could be narrowed by further research in the areas of endogenous emissions and atmospheric chemistry. This uncertainty is narrow over the next 15 years, but is quite large after 50 year or longer periods. 20 refs., 5 tabs.

23069 (UBA-FB—87-092/END) Measurement and assessment of the heavy metal emissions from selected installations and suggested measures for their reduction. Final report. Luetzke, K.; Grossmann, W.; Sobottka, H.; Toelle, J. (Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Zentralabteilung Emissionsmessungen; Umweltbundesamt, Berlin (Germany, F.R.)). 31 Oct 1987. 236p. (In German). Copy held by UB/TIB Hannover.. Order Number DE89107019/JAW.

Extensive investigations were carried out on 13 different large-scale industrial, small-scale industrial or municipal installations, to analyse the emissions of selected heavy metals and trace elements and the element-specific emission factors. The enrichment in the field of small grain fractions was also investigated on some installations using impactor measurements. The flue-dust samples were supplemented by samples taken from the input materials and the waste materials in order to draw up a balance sheet of the materials of interest here for the individual installations. The analyses of the samples to check for - as a maximum - As, Be, Cd, Cr, Cu, Hg, Mn, Ni, Pb, Te, Tl, V, Zn as well as Cl, F and S took place in our laboratory, and mainly atom absorption spectrometry was used. In a cooperative test, some of the results of our analyses were checked by 3 other laboratories. On several installations, gaseous inorganic waste gas components were measured, e.g. SO/sub 2/. On the basis of all the test results obtained, measures were suggested to reduce emissions. The measurements taken were supplemented by nationwide records for the type of installations investigated. From the results recorded and the emission factors determined, the annual sector-related heavy metal and trace element emissions in the Federal Republic of Germany were estimated. (orig.) With 32 refs., 62 tabs., 23 figs.

23070 Infrared fluorescence from NO_2 excited at 400--500 nm. McAndrew, J.J.F.; Preses, J.M.; Weston R.E. Jr.; Flynn, G.W. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics;* **90**: No. 9, 4772-4782(1 May 1989).

NO_2 has been electronically excited to the $^2B_2/^2B_1$ states, using pulsed dye laser radiation at 400--500 nm. Strong mixing of the electronically excited state with the ground electronic state ($^2A_1$) leads to highly vibrationally excited $NO_2(^2A_1)$, from which infrared emission has been observed. The time dependence of the IR fluorescence at several wavelengths has been observed, and quenching rate constants for NO_2 and other gases have been measured. In addition to IR fluorescence at wavelengths identifiable as vibrational transitions (3.0--4.0, 6.1--6.8, 7.4--8.5, and 10.0--14.0 μm), emission at wavelengths <3.0 μm has been observed and attributed to a transition with electronic character. The emission observed in these experiments has been compared with that of chemiluminescent NO_2 produced in the $O+NO$ and O_3+NO reactions.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 21689, 21812, 21829, 21831, 21853, 21854, 22114, 22170, 22171, 22172, 22173, 22174, 22175, 22176, 22177, 22178, 22180, 22181, 22182, 22193, 22194, 22201, 22213, 22247, 23047, 23052, 23105, 23177, 23185, 23190

23071 (AERE-R—13038) Deposition of /sup 14/CO/sub 2/ in rain. Garland, J.A. (UKAEA Harwell Lab. Environmental and Medical Science Div.). May 1988. 15p. H.M. Stationery Office, London, price Pound 8.00.

Information in the literature has been used to estimate the rate of deposition of /sup 14/CO/sub 2/ in rain. Little attention has been paid to this route of removal for atmospheric carbon dioxide, but calculations show that the rate of removal is slight. The washout ratios are five or six orders of magnitude smaller than corresponding values for particulate tracers or more reactive gases. The rate of deposition of /sup 14/CO/sub 2/ in rain is expected to be negligible in comparison with uptake by plants during photosynthesis but may be dominant when plants are dormant at night or in cold weather.

23072 (ICEFIZ-RB—21-1987) Gamma ray spectra recorded from the fallout collected in May 1986. Cristu, M.I. (Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania)). (Central Inst. of Physics, Bucharest (Romania)). Jul 1987. 26p. (In Romanian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706021/JAW.

An analysis of the gamma ray spectra recorded from the fallout collective in Bucharest and Brasov in May, 1986 was carried out. Relative activities of the assigned radionuclides were computed and the duration of the /sup 235/U fuel irradiation has been deduced.

23073 (ICEFIZ-RB—22-1987) /sup 131/I and /sup 137/Cs fallout in May 1986 in Bucharest-Magurele area. Iorgulescu, A. (Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania)). (Central Inst. of Physics, Bucharest (Romania)). Aug 1987. 4p. (In Romanian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706022/JAW.

The activities of I-131 and Cs-137 in fallout in Bucharest-Magurele area, during May 1986 is presented.

23074 (ICEFIZ-RB—23-1987) /sup 89/Sr and /sup 90/Sr in atmospheric precipitations in May 1986 in Bucharest-Magurele area. Paunescu, N.; Vata, I. (Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania)). (Central Inst. of Physics, Bucharest (Romania)). Aug 1987. 4p. (In Romanian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706023/JAW.

Sr-89 and Sr-90 were determined in the fallout of May 1986. The maximum values of 335 Bq/(m/sup 2/* 6 hours) and 110 Bq/(m/sup 2/* 6 hours) were observed at May 2 and 5. Throughout May 1986 a quantity of 860 Bq/m/sup 2/ of Sr-90 deposited from the fallout in the Bucharest -Magurele area was determined. (authors).

23075 (ICEFIZ-RB—24-1987) /sup 90/Sr and /sup 137/Cs in atmospheric fallout in 1986 in Bucharest-Magurele area. Iorgulescu, A.; Paunescu, N. (Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania)). (Central Inst. of Physics, Bucharest (Romania)). Oct 1987. 4p. (In Romanian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706024/JAW.

Activities of Sr-90 and Cs-137 in the fallout in the Bucharest -Magurele area, during May 1986 is presented in this work. The highest activities have been obtained for the first decade of May. After that, the content of fallout in Sr-90 and Cs-137 decreased continual since last month of 1986 (authors).

23076 (OEVS-Mitteilung—2/1988, pp 27-29) **Environment radioactivity in Austria. Measurements of the Ministry of Health and Environment.** Schoenhofer, F.; Henrich, E. (Umweltbundesamt, Vienna (Austria)). 1988. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88706267/JAW. (CONF-8505399—).

From Austrian Radiation Protection Association - spring convention 1985; Vienna, Austria (1 May 1985).

The Austrian Surveillance System for Environmental Radioactivity is described and some results are presented.

23077 **(PNL-SA—16432) Preliminary results of the MLAM [Multi-Layer Air Mass] Lagrangian transport model simulation of ANATEX [Across North America Tracer Experiment].** Davis, W.E.; Olsen, A.R.; Erb, T.A. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1989. Contract AC06-76RL01830. 5p. (CONF-890135—8). NTIS, PC A02 - OSTI. Order Number DE89008123/JAW.

From American Meteorological Society; Anaheim, CA, USA (29 Jan 1989).

The 1987 Across North America Tracer Experiment (ANATEX), for the study of regional to continental-scale transport and diffusion, released perfluorocarbon tracers for three hours every 2.5 days in January, February and March (Draxler et. al. 1985, 1987). The experiment resulted in 33 days of releases at two sites; Glasgow, Montana and St. Cloud, Minnesota. Each release consisted of approximately 50 kg of perfluoro-ortho-dimenthoyl-cyclohexane (PDCH) at St. Cloud and 83 kg of perfluoro-trimethyl-cyclohexane (PTCH) at Glasgow. The experiment included the release of a third tracer, 50 kg of perfluoro-methyl-cyclohexane (PMCH), every five days from St. Cloud; designed to serve as a means to distinguish consecutive releases from St. Cloud. A surface sampling network of 77 sampling sites, located east of 105{degree} longitude in the United States and Canada, measured 24-hour average tracer concentrations out to a distance of 3000 km from Glasgow. The network, organized in eight arcs east of Glasgow, collected daily concentrations of each tracer from January 5 through March 29, 1987. The network design provides average daily surface footprint information for the three tracers. 8 refs., 2 figs.

23078 **(UCRL—97615) A hydrostatic mesoscale model using finite element and finite difference techniques.** Chan, S.T.; Leone, J.M., Jr.; Lee, R.L. (Lawrence Livermore National Lab., CA (USA)). Nov 1988. Contract W-7405-ENG-48. 11p. (CONF-890479—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004781/JAW.

From 7. international conference on finite element methods in flow problems; Huntsville, AL, USA (3 Apr 1989).

A mesoscale model capable of treating variable terrain is described herein. The model, based on the hydrostatic and anelastic approximations, has been developed with a primary goal of providing, in real time, physically realistic and accurate wind fields and atmospheric stability information to drive a pollutant transport model in emergency response situations. A hybrid method which employs both finite element and finite difference techniques is used to solve the prognostic and diagnostic variables respectively. The applicability and efficiency of the model is demonstrated in a simulation of the development of the nocturnal down-valley circulation system in Brush Creek, Colorado. 11 refs., 4 figs.

23079 **(WR—87-4) Verification of an objective analysis scheme. Meteorological analyses after the Chernobyl disaster verified by trajectories of radioactive air masses.** Cats, G.J.; Haan, B.J. de; Hafkenscheid, L.M.; KNMI - Ministerie van Verkeer en Waterstaat Collaboration. (Koninklijk Nederlands Meteorologisch Inst., De Bilt; Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands)). (Koninklijk Nederlands Meteorologisch Inst., De Bilt). 1987. 32p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706136/JAW.

An intermittent data assimilation scheme has been used to produce wind and precipitation fields during the 10 days after the explosion at the Chernobyl nuclear power plant on 25 April 1986. The wind fields are analyses, the precipitation fields have been generated by the forecast model part of the scheme. The precipitation fields are of fair quality. The quality of the wind fields has been monitored by the ensuing trajectories. These were found to describe the arrival times of radioactive air in good agreement with most observational data, taken all over Europe. The wind analyses are therefore considered to be reliable. 25 refs.; 13 figs.

5004 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 23052

5005 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 21941

5006 Regulations

REFER ALSO TO CITATION(S) 21690, 23065

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

23080 **(CONF-8809168—5) Environmental monitoring of biological markers in animals and plants.** McCarthy, J.F.; Adams, S.M.; Jimemez, B.D.; Shugart, L.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007830/JAW.

From 2. US-USSR symposium on air pollution effects on vegetation; Gatlinburg, TN, USA (21 Sep 1988).

In an environmental monitoring plan, a suite of biomarkers are measured in wild animal or plant species sampled from areas of suspected contamination and from pristine reference environments. Based on the magnitude and pattern of the biomarker responses, the environmental species offer the potential of serving as sentinels demonstrating the presence of bioavailable contaminants, surrogates indicating potential human exposure and effects, and predictors of long-term ecological effects. 15 refs., 3 figs., 2 tabs.

23081 **(DOE/ER/60297—5) Compensatory mortality in mule deer populations: Final technical report, January 1, 1985--December 31, 1988.** White, G.C. (Colorado State Univ., Fort Collins (USA). Dept. of Fishery and Wildlife Biology). 1 Mar 1989. Contract FG02-85ER60297. 30p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009076/JAW.

The hypothesis of compensatory mortality is critical to understanding population dynamics of wildlife species. This knowledge is vital regardless of whether populations are managed for recreational hunting or habitats are altered via energy development projects. This research tested for compensatory mortality in the juvenile (fawn) portion of a mule deer population. Two experimental manipulations were used employing radio-collared deer. In this study, {approximately}20% of the population was moved from a treatment area and fawn survival rates compared to those on the control area. In the pasture study, deer were stocked in pastures at 3 densities of 44, 89, and 139 deer/km^2. Lowering of density in the field portion of the study did not appear to affect fawn survival. This is attributed to not removing enough animals for existing range conditions that have been imparted by high deer densities during the last 3 decades. Also, the effect of removal was tempered by an increase in yearling males brought about by antler-point restrictions during the harvest. Deer removed from the treatment area were used to stock 3 large pastures at low, medium, and high densities of 44, 89, and 139 deer/km^2, respectively. Fawn survival was significantly different between densities ($P < 0.001$), with the low density pasture showing the highest survival and the high density pasture showing the lowest survival. The main cause of death was starvation suggesting that food supplies were limiting. A strong compensatory mortality process is operating in this mule deer popu-

lation as evidenced by the pasture data. We did not detect this process in the field portion of the study because the removal of {approximately}20% of the population was insufficient to allow an immediate improvement in fawn nutrition. The density-dependent survival response in the controlled pasture study demonstrated that compensatory mortality is operating in this population. 57 refs., 7 figs., 6 tabs.

23082 **(ORNL/TM—11128) Regional ecological risk assessment: Theory and demonstration.** Hunsaker, C.T.; Graham, R.L.; Suter, G.W. II; O'Neill, B.L.; Jackson, B.L.; Barnthouse, L.W. (Oak Ridge National Lab., TN (USA)). Mar 1989. Contract AC05-84OR21400. 114p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008983/JAW.

Society needs a quantitative and systematic way to estimate and compare the impacts of environmental problems that effect large geographic areas. This report presents an approach for regional ecological risk assessment that combines regional assessment methods and landscape ecology theory with an existing framework for ecological risk assessment. Risk assessment evaluates the effects of an environmental change on a valued natural resource and interprets the significance of those effects in light of the uncertainties identified in each component of the assessment process. The components of regional risk are defined, and the similarities and differences between regional and local risk assessment are discussed in this report. Unique and important issues for regional risk assessment are emphasized; these include the definition of the disturbance scenario, the assessment boundary definition, and the spatial heterogeneity of the landscape. We present an in-depth discussion of possible endpoints for regional assessments and criteria for judging endpoints. The nature of the assessment problem influences the appropriate choice of endpoints. A demonstration of a regional risk assessment is used to illustrate the components of the assessment framework, to test the utility of the approach, and to highlight unique aspects of regional assessment such as spatial heterogeneity, landscape pattern, and the need to link ecological systems through the use of models. 100 refs., 6 figs., 13 tabs.

23083 **(UCRL—99435) Use of the 1:2,000,000 digital line graph data in emergency response.** Walker, H. (Lawrence Livermore National Lab., CA (USA)). Jan 1989. Contract W-7405-ENG-48. 13p. (CONF-8904117—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006730/JAW.

From American Society for Photogrammetry and Sensing/ American Congress on Surveying and Mapping Auto-Carto 9 annual convention; Baltimore, MD, USA (2 Apr 1989).

Environmental emergencies often have effects that are distributed over the earth's surface. As a result, maps are usually the most effective way to portray the impact of an emergency. The Atmospheric Release Advisory Capability (ARAC) at Lawrence Livermore National Laboratory is an emergency response organization that utilizes computer-assisted cartography. ARAC provides real-time assessments of the consequences of atmospheric releases of radioactive material. The products of this service are isopleths of the material concentration plotted over a base map of geographic features. Because ARAC's commitments encompass the entire United States, the ability to produce base maps anywhere in the United States is very important. At present ARAC is using data derived from the United States Geological Survey's 1:2,000,000 Digital Line Graph (DLG) database to meets its small-scale mapping needs. The DLG data set contains much of the information needed to serve in this emergency response application. However, certain enhancements are required to produce the necessary base maps. To create a data set suitable for ARAC, several preprocessing steps are needed. These include transforming the coordinate system, extracting relevant features as individual entities, correcting coding errors, and matching the edges along adjacent sectional files. 14 refs., 7 figs.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 21648, 22452, 23061, 23101, 23182, 23207, 23227

23084 **(CONF-8810317—1) Defensibility of environmental technical data.** Knudson, D.A. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007502/JAW.

From 16. environmental symposium on environmental compliance and enforcement at DOD installations; New Orleans, LA, USA (18 Oct 1988).

This paper presents a comprehensive framework for constructing a defensible environmental data set, in the context of application to sampling and analysis conducted for the DoD Installation Restoration Program (IRP). The framework represents a hybrid between quality assurance (QA) elements and guidance provided by the American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME) and the US Environmental Protection Agency (EPA). As will be discussed, the QA framework can be used as a basis for structuring IRP projects that meet both US Army Toxic and Hazardous Materials Agency (USATHAMA) and EPA requirements. The framework uses a programmatic or top-down approach that not only supports developing a comprehensive plan ensuring a high level of data defensibility, but also eases the modification of QA plan requirements to meet objectives specific to individual sampling and analysis projects. 1 tab.

23085 (IAEA-AL—004, pp 17) **Inorganic analysis of foods quality assurance considerations.** Horwitz, W. (Food and Drug Administration, Washington, DC (USA)). Oct 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88705971/JAW. (CONF-8710451—).

From IAEA-NBS international workshop on practical analytical approaches to the assessment of human dietary intake of nutrients, toxic constituents and radionuclides; Gaithersburg, USA (2 Oct 1987).

23086 (IAEA-AL—004, pp 18) **Dietary analytical reference materials - Past and future.** Wolf, W.R. (Department of Agriculture, Beltsville, MD (USA). Nutrient Composition Lab.). Oct 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88705971/JAW. (CONF-8710451—).

From IAEA-NBS international workshop on practical analytical approaches to the assessment of human dietary intake of nutrients, toxic constituents and radionuclides; Gaithersburg, USA (2 Oct 1987).

23087 (IAEA-AL—004, pp 19-20) **Inorganic constituents in diets: Some analytical considerations.** Iyengar, V. (National Bureau of Standards, Gaithersburg, MD (USA)). Oct 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88705971/JAW. (CONF-8710451—).

From IAEA-NBS international workshop on practical analytical approaches to the assessment of human dietary intake of nutrients, toxic constituents and radionuclides; Gaithersburg, USA (2 Oct 1987).

23088 (IAEA-AL—004, pp 21-22) **Difficult trace elements in food: The role of activation analysis.** Byrne, A.R. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Oct 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88705971/JAW. (CONF-8710451—).

From IAEA-NBS international workshop on practical analytical approaches to the assessment of human dietary intake of nutrients, toxic constituents and radionuclides; Gaithersburg, USA (2 Oct 1987).

23089 (IAEA-AL—004, pp 23-24) **Toxic trace elements in food - A methodological appraisal.** Dabeka, R.W. (Bureau of Chemical Safety, Ottawa, Ontario (Canada). Food Research Div.). Oct 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88705971/JAW. (CONF-8710451—).

From IAEA-NBS international workshop on practical analytical approaches to the assessment of human dietary intake of nutrients, toxic constituents and radionuclides; Gaithersburg, USA (2 Oct 1987).

23090 (IAEA-AL—004, pp 25) **Large scale population survey studies.** Briefel, R. (National Center for Health Statistics, Hyattsville, MD (USA)). Oct 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88705971/JAW. (CONF-8710451—).

From IAEA-NBS international workshop on practical analytical approaches to the assessment of human dietary intake of nutrients, toxic constituents and radionuclides; Gaithersburg, USA (2 Oct 1987).

23091 (IAEA-AL—004, pp 29) **Analysis of organic micronutrients in vegetables.** Khachik, F.; Beecher, G.R. (Department of Agriculture, Beltsville, MD (USA). Nutrient Composition Lab.). Oct 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88705971/JAW. (CONF-8710451—).

From IAEA-NBS international workshop on practical analytical approaches to the assessment of human dietary intake of nutrients, toxic constituents and radionuclides; Gaithersburg, USA (2 Oct 1987).

23092 **(NP—9770313) Economic evaluation of pollution damage to forest ecosystems.** Moehring, B.; Moog, M.; Brabaender, H.D. (Goettingen Univ. (Germany, F.R.). Inst. fuer Forstliche Betriebswirtschaftslehre; Bundesministerium fuer Ernaehrung, Landwirtschaft und Forsten, Bonn (Germany, F.R.); Commission of the European Communities, Brussels (Belgium)). 28 Apr 1986. 41p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE89770313/JAW.

The aim of the research project was to work out a basis for the evaluation of large-scale pollution-related damage to forests from a business and economic point of view. To this end the decreases in profits and increases in expenditure arising on a business level were to be recorded and quantified through a business analysis, whereby the detailing of natural measurable alterations in forest growth in economic terms was especially important. The alteration in the flow of benefits for the national economy was to be recorded and evaluated by means of an economic analysis; this was to take into account forestry products which are dealt in via markets as well as public goods.

23093 **(ORNL/Sub—88-14384/1) Feasibility testing of in situ vitrification or Arnold Engineering Development Center contaminated soils.** Timmerman, C.L. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1989. Contract AC05-84OR21400. 44p. (PNL—6780). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008976/JAW.

Process feasibility studies using in situ vitrification (ISV) were successfully performed on two different site soils from the southern portion of middle Tennessee. In situ vitrification is a thermal treatment process that converts contaminate soils and wastes into a durable glass and crystalline form. During processing, heavy metals or other inorganic constituents are retained and immobilized in the glass structure; organic constituents are typically destroyed or removed for capture by the off-gas treatment system. The bench-scale ISV testing results,reported herein, indicate that the two AEDC sites may be successfully processed by ISV. Site 1 is a general landfill area for which ISV processed clean soil to prove that ISV could melt the soil type from that area. The other area, Site 10, is a fire training pit that is contaminated with fuel oils and heavy metals from fire training exercises. Actual site material was processed by ISV to determine its feasible application to those contaminated soils. Initial testing and analyses of the soils determined that a lower melting, electrically conductive, fluxing additive (such as sodium carbonate) is required as an addition to the soil for ISV processing to work effectively. With the additive, ISV processing was successful on both soil types. With the high destruction or organics and high retention of inorganics in the melt, the small percentage of particulate and gaseous releases can be effectively retained by a conventional wet scrubbing and filtering system appropriately designed to meet necessary criteria established for airborne releases. 7 refs., 15 figs., 4 tabs.

23094 **Blood, sweat, tears and success of technology transfer long-term controlled-release of herbicides.** Van Voris, P.; Cataldo, D.A.; Burton, F.G.; Skeins, W.E. (Pacific Northwest Lab., Richland, WA (US)). *Nuclear Materials Management. Annual Meeting Proceedings;* **17**: 224-232(1988). (CONF-880631—).

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

The problems encountered, the technical difficulties that had to be overcome, and the successful transfer of technology related to controlled-release of pesticides is reviewed. Research on control-release of pesticides to date has resulted in products designed to extend bioactivity for periods of several days, months, or at most, several years. However, research supported by the U.S. Department of Energy directed toward solving problems associated with plant-root penetration through caps and liners engineered to minimize leaching or movement of buried nuclear and chemical wastes has resulted in development of a long-term controlled-release herbicide delivery system designed to stop root growth for periods of up to 100 years. Through the unique combination of polymers with a herbicidally active dinitroaniline, a cylindrical pellet was developed that continuously releases a herbicide for a period of up to 100 years. Equilibrium concentration of the herbicide in soil adjacent to the pellet and the bioactive lifetime of the device can be adjusted by changing the size of the pellet; the type of polymer; the type, quality, and quantity of carrier; and/or the concentration and type of dinitroaniline was used.

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REFER ALSO TO CITATION(S) 21689, 21812, 21832, 22114, 22179, 22183, 22190, 22193, 22194, 22241, 22243, 23047, 23076, 23190

23095 **(ANL-ESH/TS—88-102) Cursory radiological assessment: Battelle Columbus Laboratory Decommissioning and Decontamination Project.** Smith, W.H.; Munyon, W.J.; Mosho, G.D.; Robinet, M.J.; Wynveen, R.A. (Argonne National Lab., IL (USA). Environment, Safety, and Health Dept.). Oct 1988. Contract W-31109-ENG-38. 153p. NTIS, PC A08/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008937/JAW.

This document reports on the results obtained from a cursory radiological assessment of various properties at the Battelle Columbus Laboratory, Columbia, Ohio. The cursory radiological assessment is part of a preliminary investigation for the Battelle Columbus Laboratory Decommissioning and Decontamination Project. The radiological assessment of Battelle Columbus Laboratory's two sites included conducting interior and exterior building surveys and collecting and analyzing air, sewer system, and soil samples. Direct radiological surveys were made of floor, wall, and overhead areas. Smear surveys were made on various interior building surfaces as well as the exterior building vents. Air samples were collected in select areas to determine concentrations of Rn-222, Rn-220, and Rn-219 daughters, in addition to any long-lived radioactive particulates. Radon-222 concentrations were continuously monitored over a 24-hr period at several building locations using a radon gas monitoring system. The sanitary sewer systems at King Avenue, West Jefferson-North, and West Jefferson-South were each sampled at select locations. All samples were submitted to the Argonne Analytical Chemistry Laboratory for various radiological and chemical analyses. Environmental soil corings were taken at both the King Avenue and West Jefferson sites to investigate the potential for soil contamination within the first 12-inches below grade. Further subsurface investigations at the West Jefferson-North and West Jefferson-South areas were conducted using soil boring techniques. 4 refs., 10 figs., 10 tabs.

23096 **(BFE-R—88-01) Radioecological investigations in the food-chain air-soil-vine-wine. Pt. 1. Transfer of fallout from nuclear weapon tests from soil to wine.** Wagner, A.; Hellmuth, K.H.; Fischer, E. (Bundesforschungsanstalt fuer Ernaehrung, Karlsruhe (Germany, F.R.)). Dec 1988. 116p. (In German). Bundesforschungsanstalt fuer Ernaehrung, Karlsruhe (Germany, F.R.).

In a field investigation (1983-1985) comprising 8 locations of the most important viticultural regions in Germany, the contents of H-3, C-14, Sr-90, and Cs-137 in air, soils, leaves of the vine, grapes and wine were measured and site-specific transfer factors were calculated. Data concerning soil parameters, climatic conditions, cultivation and vinification were collected. The T contents of all samples were 10 Bq/l water of combustion, independent of location and year. The specific activity of C-14 in the atmosphere and in biological material was 0.22 Bq/g C, independent of site and year. Sr-90 contents of soils fluctuated between 0.7 and 3.5 Bq/kg dry matter. The mean content of leaves was 2 Bq/kg fresh material, of grapes 0.035 Bq/kg and of wine 0.008 Bq/l. The Cs-137 level of soils fluctuated between 1.3 and 7.9 Bq/kg dry matter. The mean content of leaves was 0.098 Bq/kg fresh material, of grapes 0.021 Bq/kg and of wine 0.0085 Bq/l. A relation between transfer and soil parameters and between the contents of grapes and wine was not recognizeable. While cultivar-specific differences were not observed in grapes, red wines contained somewhat more Cs-137 than white wines. Transfer factors soil-grapes were 0.027 for Sr-90 and 0.0057 for Cs-137. Site-specific influences such as soil parameters, climate, cultivation, vinification and differences between years led to a small fluctuation of values. No influence of the Neckarwestheim reactor has been found in any of the radionuclides.

23097 **(CIEMAT—618) Determination of Ra-226 by gamma-ray spectrometry.** Martinez Lobo, A. (Junta de Energia Nuclear, Madrid (Spain)). 1988. 32p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705617/JAW.

This work deals with the method of determination of /sup 226/Ra by low energy photon spectrometry. For this purpose, the interference due to /sup 235/U, that emits a photon with a close energy, has to be considered. The contribution of /sup 235/U to the 186 KeV photopeak is studied through the 63 KeV /sup 234/Th and the 144 KeV /sup 235/U emissions. From the minimum detectable activity of /sup 226/Ra it is discussed the applicability of this method to several kind of samples.

23098 (EUR—11408, pp 200-207) **Particle transport in urban dwellings.** Cannell, R.J.; Goddard, A.J.H.; ApSimon, H.M. (Imperial Coll. of Science and Technology, London (UK). Dept. of Mechanical Engineering). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

A quantitative investigation of the potential for contamination of a dwelling by material carried in on the occupants' footwear has been completed. Data are now available on the transport capacity of different footwear for a small range of particle sizes and contamination source strengths. Additional information is also given on the rate of redistribution.

23099 (EUR—11408, pp 222-235) **Seasonality and uncertainty aspects of ingestion dose: some preliminary results.** Nair, S.; Ponting, A.C. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88757197/JAW. (CONF-8801124—).

From OECD-NEA/CEC workshop on recent trends in the evaluation of reactor accident consequences; Rome, Italy (25 Jan 1988).

This paper presents preliminary results of a study of the seasonality and uncertainty aspects of individual ingestion dose. The primary objective of the work is to determine the uncertainty in ingestion dose estimates arising from uncertainties in the foodchain transfer and in the internal (human) dosimetry for scenarios where the terrestrial foodchain pathway is important. A subsidiary objective is to estimate the sensitivity of these uncertainties to the statistical sampling method chosen. The foodchain transfer calculations utilized the CEGB's generic dynamic foodchain model for transfer to crops and to animal products. The animal product model was, however, run for an assumed agricultural practice that was fixed year-on-year. This allowed for analytical solutions to the model equations to be derived and used, in contrast to the more general but computing time-consuming numerical solution approach that is conventionally adopted within the CEGB model. Calculations were made of the dependence of the transfer on a number of foods from discrete depositions of I-131, Cs-134 and Cs-137 occurring at different times of the year. The observed time variations were interpreted in terms of the dominant transfer processes and scenarios identified where the ingestion pathway is dominant. Details were presented of a coupled foodchain/human metabolic model for ingestion of I-131 in milk which were also subjected to uncertainty analysis.

23100 **(GKSS—88/E/27) Natural and artificial radioactivity in food.** Wilken, R.D. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Chemie). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1988. 10p. (In German). Special print from Ernaehr.-Umsch. (1987) v. 34 p. 470-477 (special issue).

By far the largest fraction of the radiation dose to the population stems from artificial radioactivity used for medical purposes (42 p.c.); the next ranking source is the Rn-222 in building materials (29 p.c.), and the third fraction is contributed by cosmic and natural radioactivity in the environment. The main sources of the body burden are K-40 and C-14. The radionuclide composition in the human body can be modified by nuclear weapons tests, reactor accidents like the one in Chernobyl, and operation of nuclear facilities, with radioactivity uptake via the food chain playing a special role. The author explains the contribution of radioactivity in food to the population exposure.

23101 **(IAEA-AL—004) IAEA-NBS international workshop. Practical analytical approaches to the assessment of human dietary intake of nutrients, toxic constituents and radionuclides.** (International Atomic Energy Agency, Vienna (Austria); National Bureau of Standards, Washington, DC (USA)). Oct 1987. 57p. (CONF-8710451—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88705971/JAW.

From IAEA-NBS international workshop on practical analytical approaches to the assessment of human dietary intake of nutrients, toxic constituents and radionuclides; Gaithersburg, USA (2 Oct 1987).

The purpose of the workshop was to seek a better understanding of the problems related to dietary research and monitoring studies. There was a general agreement that more natural matrix standard reference materials (SRM), especially for radionuclides, should be developed. These should focus on organic nutritients, radionuclides, pesticides, and industrial chemicals, in addition to the ongoing efforts to certify inorganic constituents. It was suggested that when SRMs are prepared, there should be a large enough quantity made for the maximum length of time possible, and the available analytical information updated. Refs, 1 fig., 1 tab.

23102 **(ICEFIZ-RB—26-1988) Study of the radfioisotopic composition of rain in 2.05 1986 in Bucharest-Magurele area.** Iorgulescu, A.; Paunescu, N.; Margineanu, R. (Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania)). (Central Inst. of Physics, Bucharest (Romania)). Jan 1988. 3p. (In Romanian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706025/JAW.

The paper presents the activities of radionuclides in the rain that fell in Bucharest-Magurele area on May 2nd, 1986. The artificial radionuclides measured were: Sr-89, Sr-90, Ru-103, Ru-106, Sb-125, I-131, (I+Te)-132, Cs-134, Cs-137, (Ba+La)-140, Ce-141, Ce-144, originating in the nuclear accident at Chernobyl. The activities of I-131 and Cs-137 were 28700 Bq/m/sup 2/ and 3610 Bq/m/sup 2/ respectively. (authors).

23103 **(ICEFIZ-RB—27-1988) Enviromental radioactivity of 1987 in Romania.** Galeriu, D.; Oncescu, M. (Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania)). (Central Inst. of Physics, Bucharest (Romania)). Feb 1988. 12p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706026/JAW.

The radioactivity of atmosphere. hydrosphere, lithosphere and biosphere from 1987 is compared with that one from preceeding years, after 1963. Estimations of the effective dose equivalent (EDE) for the natural, additional (due to man-made releases), medical and occupational exposure are given. (authors).

23104 **(INIS-GB—175) Terrestrial radioactivity monitoring programme (TRAMP) report for 1986. Radioactivity in food and agricultural products in England and Wales - no. 1.** (Ministry of Agriculture, Fisheries and Food, London (UK)). 1988. 44p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705765/JAW.

The Ministry of Agriculture, Fisheries and Food (MAFF) undertakes a comprehensive independent monitoring programme for radioactivity in terrestrial foodstuffs in England and Wales, this report presents the results from the first full year of operation of this programme and complements the data published annually by the Ministry's Directorate of Fisheries Research in respect of the aquatic environment. This work is undertaken in Wales on behalf of the Secretary of State. The Terrestrial Radioactivity Monitoring Programme (TRAMP) concentrates on samples of agricultural produce (milk, crops, meat) collected from the vicinity of the major nuclear sites in England and Wales and is independent of monitoring undertaken for various purposes by site operators.

23105 **(JAERI-M—88-232) Experimental results of JAERI in the Canadian HT field release study of June 10, 1987.** Murata, Mikio; Noguchi, Hiroshi; Matsui, Tomoaki and others. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Nov 1988. 94p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757265/JAW.

A tritium gas (HT) release study was performed in Chalk River Nuclear Laboratories, Ontario, Canada, on June 10, 1987. About 3.5 x 10/sup 12/ Bq (96 Ci) of HT gas was released to an experimental field over 30 minutes from an outlet placed at 1 m height from the ground surface. From measurements of air, soil and pine needle samples collected during the extended period of 5 days after initiation of the HT release, the following findings were obtained. HT gas was deposited in the soil through diffusion into the soil and conversion to HTO by microbial activity therein. The concentration ratio of HTO to HT in the air during the release period tended to increase with downwind distance and was 4.1 x 10/sup -4/ at 400 m. Soil measurements showed that HT gas was deposited in the soils as HTO, mostly in the top 5 cm soils and its deposition velocities to the soils ranged from 1.6 x 10/sup -4/ to 3.0 x 10/sup -4/ m/s. A low deposition velocity of $<$1.0 x 10/sup -5/ m/s was measured for the silty loam with low microbial activity. The deposition velocities for the coarse sands were comparable to those for the very fine sandy loam. The deposition velocities for resuspended HTO to the silty loam, ethylene glycol and water were 2.4 x 10/sup -2/, 1.5 x 10/sup -2/ and 2.3 x 10/sup -2/ m/s, respectively. Pine needle measurement showed that HT deposition was negligible as compared with HTO deposition. Due to deposition of air HTO, the tissue-free-water-tritium concentration increased with time and reached a peak concentration in 5 hours. This fact suggested that vapor exchange between air and vegetation was an important process. Uptake of HTO by roots was seen from about 50 hours after the end of the HT release.

23106 **(NAGRA-NTB—87-40/1) 3-D migration experiment - Report 3, Part 1: Performed experiments, results and evaluation.** Abelin, H; Birgersson, L.; Gidlund, J.; Moreno, L.; Neretnieks, I.; Widen, H.; Agren, T. (Royal Inst. of Tech., Stockholm (Sweden)). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Nov 1987. 351p. Nagra, CH-5401 Baden, Switzerland.

This report is one of the four reports describing the Stripa 3D experiment where water and tracer flow has been monitored in a specially excavated drift in the Stripa mine. The experiment was performed in a specially excavated drift at the 360 m level in granite. The whole ceiling and upper part of the walls were covered with more than 350 individual plastic sheets where the water flow into the drift could be collected. 11 different tracers were injected at distances between 11 and 50 m from the ceiling of the drift. The flowrate and tracer monitoring was kept up for more than two years. The tracer breakthrough curves and flowrate distributions were used to study the flow paths, velocities, hydraulic conductivities, dispersivities and channeling effects in the rock. The present report describes the structure of the observations, fracture mapping the flowrate measurements and how these were used to estimate the hydraulic conductivities. The main part of this report addresses the interpretation of the tracer movement in the rock outside the drift. The tracer movement as measured by the more than 160 individual tracer curves has been analyzed with the traditional advection-dispersion model, but also with more recent models which include the effects of channeling and the diffusion of tracers into stagnant waters in the rock matrix and in stagnant waters in the fractures themselves. The tracer experiments have permitted the flow porosity and dispersion to be studied. (author) 45 refs., 214 figs., 69 tabs.

23107 **(NAGRA-NTB—87-40/2) 3-D migration experiment - Report 3, Part 1: Performed experiments, results and evaluation.** Abelin, H; Birgersson, L.; Gidlund, J.; Moreno, L.; Neretnieks, I.; Widen, H.; Agren, T. (Royal Inst. of Tech., Stockholm (Sweden)). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Nov 1987. 460p. Nagra, CH-5401 Baden, Switzerland.

This appendix gives all the tracer breakthrough curves. Information about injection are given on each plot. The concentration of the tracers Eosin B, Uranine, Elbenyl, Eosin Y and Duasyn are given in ppm and the concentration of Iodide and Bromide is given in M. Explanation to the plot is given. 717 figs.

23108 **(NAGRA-NTB—87-41) 3-D migration experiment - Report 4: Fracture network modelling of the Stripa 3-D site.** Andersson, J.; Dverstorp, B. (Royal Inst. of Tech., Stockholm (Sweden)). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Nov 1987. 40p. Nagra, CH-5401 Baden, Switzerland.

This report is one of the four reports describing the Stripa 3D experiment where water and tracer flow has been monitored in a specially excavated drift in the Stripa mine. The experiment was performed in a specially excavated drift at the 360 m level in granite. The whole ceiling and upper part of the walls were covered with more than 350 individual plastic sheets where the water flow into the drift could be collected. 11 different tracers were injected at distances between 11 and 50 m from the ceiling of the drift. The flowrate and tracer monitoring was kept up for more than two years. The tracer breakthrough curves and flowrate distributions were used to study the flow paths, velocities, hydraulic conductivities, dispersivities and channeling effects in the rock. The present report describes how fracture statistics and a fracture network model have been used to interpret the flow pattern in the 3D-drift. (author) 20 refs., 7 figs., 13 tabs.

23109 **(ORNL/RASA—86/82) Results of the radiological survey at 20 Yardboro Avenue, Albany, New York.** Marley, J.L. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009412/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 20 Yardboro Avenue in Albany, New York, was the subject of a radiological investigation initiated May 5, 1986. The property was a residence consisting of a house and garage. The house was single story with white siding. The two-car garage was at the rear of the lot and was connected with the street by an asphalt driveway. A diagram of the property showing the approximate boundaries and a 5-m grid network established for measurements outside the house is shown. The

rectangular lot included in the radiological survey was {approximately}19 m wide by 35 m deep. Front and rear views of the property are shown. 13 refs., 6 figs., 5 tabs.

23110 **(ORNL/RASA—87/4) Results of the radiological survey of State of New York land between 80--110 Yardboro Avenue, Albany, New York (AL151).** Hall, S.C.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009182/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property between 80--110 Yardboro Avenue, Albany, New York, was the subject of a radiological investigation initiated June 8, 1986. The property consists of a vacant parcel with not structures on a rectangular lot. A concrete slab extends onto the lot from the property to the east. A diagram of the property showing the approximate boundaries and the 20-m grid network established for measurements are shown. The rectangular area included in the radiological survey was {approximately}120 m wide by 34 m deep. Two views of the property are shown. The red brick building partially showing in the background is the former NL Industries Plant. 13 refs., 6 figs., 4 tabs.

23111 **(ORNL/RASA—87/7) Results of the radiological survey at 19 North Elmhurst Avenue, Colonie, New York (AL150).** Hall, S.C.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009199/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 19 North Elmhurst Avenue in Colonie, New York, was the subject of a radiological investigation initiated June 5, 1986. The residential property consists of a two-story house with a separate garage located on a rectangular lot. An asphalt driveway connected the garage to the street. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}15 m wide by 37 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23112 **(ORNL/RASA—87/10) Results of the radiological survey at 10/14 Kraft Avenue, Colonie, New York (AL148).** Hall, S.C.; Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009198/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 10/14 Kraft Avenue in Colonie, New York was the subject of a radiological investigation initiated June 2, 1986. The commercial property consists of a brick office building (Building 1), a brick and concrete structure (Building 2), and a metal and concrete structure (Building 3), located on an irregular lot. An asphalt driveway connects the metal building to the street. A diagram of the property showing the approximate boundaries and the 10-m grid network established for measurements outside the buildings is shown. The lot included in the radiological survey was {approximately}90 m wide by 137 m deep. Front and rear views of the property are shown. 13 refs., 7 figs., 6 tabs.

23113 **(ORNL/RASA—87/38) Results of the independent radiological verification survey at 826 Black Oak Ridge Road, Wayne, New Jersey.** Yalcintas, M.G.; Carrier, R.F.; Crutcher, J.W. (Oak Ridge National Lab., TN (USA)). Sep 1988. Contract AC05-84OR21400. 22p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008581/JAW.

In January 1981 the NRC measured direct radiation levels and radionuclide concentration in soils on the W.R. Grace property. The results of the survey indicated radiation levels ranging from 10 to 1000 microroentgens per hour (μR/h) and ^{232}Th concentrations as high as 1200 picocuries per gram (pCi/g) of soil. Therefore, the state of New Jersey requested an aerial radiological survey, which was conducted in May 1981. This survey identified elevated radiation levels at 1 m above the surface with average exposure rates greater than 120 μR/h. It was determined that a more detailed radiological survey of the plant site was needed to provide information on the extent and degree of the contamination. A radiological survey at the processing facility was performed in July 1982 by Oak Ridge Associated Universities (ORAU) for the NRC, and a similar survey was conducted in 1982 by the New Jersey Department of Environmental Protection (NJDEP). Because it was noted that elevated radiation levels extended onto the property adjacent to the W.R. Grace Site on the south (a school bus maintenance facility and depot), this property at 826 Black Oak Ridge Road was surveyed by ORAU. These surveys indicated surface radionuclide concentrations greater than those acceptable under US Department of Energy (DOE) remedial action guidelines. 11 refs., 3 figs., 6 tabs.

23114 **(ORNL/RASA—87/71) Results of the radiological survey at 7 Oakland Avenue, Colonie, New York (AL129).** Marley, J.L. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009169/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 7 Oakland Avenue in Colonie, New York, was the subject of a radiological investigation initiated November 8, 1985. The residential property consisted of a one and one-half-story house located on a quadrilateral lot. An asphalt-paved walkway and driveway were placed across the front and at the east side of the house, respectively. A diagram of the property showing the approximate boundaries and the 6-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}24 m wide by 35 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23115 **(ORNL/RASA—87/72) Results of the radiological survey at 1 North Oakland Avenue, Albany, New York (AL131).** Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009174/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 1 North Oakland Avenue in Colonie, New York, was the subject of a radiological investigation initiated May 12, 1986. The property consisted of a house and a garage located on a rectangular lot. An asphalt-paved driveway extended from North Oakland, a privately owned roadway, to the garage located at the rear of the lot. A diagram of the property showing the approximate boundaries and the 4-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}30.5 m wide by 33 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23116 **(ORNL/RASA—87/73) Results of the radiological survey at 1137 Central Avenue, Colonie, New York (AL132).** Marley, J.L. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 22p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009200/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 1137 Central Avenue in Colonie, New York, was the subject of a radiological investigation initiated November 10, 1985. The business property

consisted of a one-story block building located on a rectangular lot. Asphalt paving had been laid on all sides of the building. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the building is shown. The lot included in the radiological survey was {approximately}15.3 m wide and 53.5 m deep. A front and rear view of the property is shown. 13 refs., 4 figs., 4 tabs.

23117 **(ORNL/RASA—87/74) Results of the radiological survey at 1139 Central Avenue, Colonie, New York (AL133).** Marley, J.L. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009415/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 1139 Central Avenue in Colonie, New York was the subject of a radiological investigation initiated November 10, 1985. The business property consisted of a block and brick building located on a rectangular lot. Asphalt paving was laid at two sides of the building. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the building is shown. The lot included in the radiological survey was {approximately}15.5 m wide by 53.5 m deep. A front and rear view of the property is shown. 13 refs., 5 figs. 5 tabs.

23118 **(ORNL/RASA—87/75) Results of the radiological survey at 9 Maplewood Avenue, Albany, New York (AL206).** Hall, S.C.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009176/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 9 Maplewood Avenue in Colonie, New York, was the subject of a radiological investigation initiated August 25, 1986. The residential property consists of a two-story frame house with a separate garage located on a rectangular lot. An asphalt driveway connects the garage to the street. A diagram of the property showing the approximate boundaries and the 4-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}13 m wide by 36 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23119 **(ORNL/RASA—87/76) Results of the radiological survey at 4A Orford Street, Colonie, New York (AL207).** Hall, S.C.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009319/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 4A Orford Street in Colonie, New York was the subject of a radiological investigation initiated August 26, 1986. The residential property consists of a two-story frame house with a separate garage located on a rectangular lot. An asphalt drive connects the garage to the street. A diagram of the property showing the approximate boundaries and 5-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}15 m wide by 32 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23120 **(ORNL/RASA—87/77) Results of the radiological survey at 1052 Central Avenue, Albany, New York (AL208).** Hall, S.C.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009264/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 1052 Central Avenue in Albany, New York, was the subject of a radiological investigation initiated August 26, 1986. The residential property consists of a two-story block and frame house with a separate garage located on a rectangular lot. An asphalt driveway connects the garage to the street. A diagram of the property showing the approximate boundaries and a 6-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}17.5 m wide by 43.5 m deep. Front and side views of the property are shown. 13 refs., 5 figs., 5 tabs.

23121 **(ORNL/RASA—87/78) Results of the radiological survey at 1047 Central Avenue, Albany, New York (AL209).** Hall, S.C.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009205/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 1047 Central Avenue in Albany, New York was the subject of a radiological investigation initiated August 26, 1986. The commercial property consists of a two-story frame building located on an irregular lot. An asphalt drive connects the property to the street. A diagram of the property showing the approximate boundaries and the 6-m grid network established for measurements outside the building is shown. The lot included in the radiological survey was {approximately}18 m wide by 60 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23122 **(ORNL/RASA—87/79) Results of the radiological survey at 1051 Central Avenue, Albany, New York (AL210).** Hall, S.C.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009320/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 1051 Central Avenue in Albany, New York was the subject of a radiological investigation initiated August 26, 1986. The residential property consists of a two story frame house located on a rectangular lot. An asphalt drive connects the property to the street. A diagram of the property showing the approximate boundaries and the 6-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}13.5 m wide by 43.5 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23123 **(ORNL/RASA—87/80) Results of the radiological survey at 1054 Central Avenue, Albany, New York (AL211).** Hall, S.C.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009204/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 1054 Central Avenue in Albany, New York was the subject of a radiological investigation initiated August 27, 1986. The commercial property consists of a two-story frame and block building located on a rectangular lot. An asphalt drive connects the working areas to the street. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the building is shown. The lot included in the radiological survey was {approximately}13 m wide by 43 m deep. Front and side views of the property are shown. 13 refs., 5 figs., 5 tabs.

23124 **(ORNL/RASA—87/81) Results of the radiological survey at 1141 Central Avenue, Colonie, New York (AL134).** Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009416/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 1141 Central Avenue in Colonie, New York, was the subject of a radiological investigation initiated November 10, 1985. The property appeared as a combined business and residential location. A brick and block building was at the front of the lot, facing Central Avenue. A two-story house was at the rear. An asphalt-paved parking lot was at the front. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the house is shown. The rectangular lot included in the radiological survey was {approximately}15.2 m wide by 53.5 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23125 **(ORNL/RASA—87/82) Results of the radiological survey at 3 Crammond Street, Colonie, New York (AL135).** Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009207/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 3 Crammond Street in Colonie, New York was subject of a radiological investigation initiated November 14, 1985. The property was a vacant, asphalt-paved lot. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements is shown. The rectangular lot included in the radiological survey was {approximately}18.5 m wide by 33.7 m deep. A front view of the property is shown. 13 refs., 4 figs., 5 tabs.

23126 **(ORNL/RASA—87/83) Results of the radiological survey at 16 Yardboro Avenue, Albany, New York (AL137).** Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009209/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 16 Yardboro Avenue in Albany, New York was the subject of a radiological investigation initiated May 5, 1986. The residential property consists of a two-story house located on a rectangular lot. An asphalt driveway was on the east side of the house, with broken paving extending to a building at the rear of the lot. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}19 m wide by 35 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23127 **(ORNL/RASA—87/84) Results of the radiological survey at 23 Yardboro Avenue, Albany, New York (AL138).** Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009216/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 23 Yardboro Avenue in Albany, New York (AL138) was the subject of a radiological investigation initiated May 7, 1986. The property was a residence with a one and one-half-story frame house located on a rectangular lot. An asphalt driveway or parking area is located at the east side of the house. An area of {approximately}10 m {times} 14 m at the rear was inaccessible. A diagram of the property showing the approximate boundaries and the 3-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}14 m wide by 36 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23128 **(ORNL/RASA—87/85) Results of the radiological survey at 1A Maplewood Avenue, Colonie, New York (AL139).** Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009171/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 1A Maplewood Avenue in Colonie, New York, was the subject of a radiological investigation initiated May 8, 1986. This property was a residence with a frame house located on an irregular-shaped lot. An asphalt driveway extends from the street to the house. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}20 m wide by 35.5 m deep. A front view of the property is shown. 13 refs., 4 figs., 5 tabs.

23129 **(ORNL/RASA—87/86) Results of the radiological survey at 3 North Elmhurst Avenue, Colonie, New York (AL159).** Espegren, M.L.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009180/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 3 North Elmhurst Avenue in Colonie, New York was the subject of a radiological investigation initiated July 14, 1987. The residential property consists of a two-story brick and frame house with a separate garage, located on a rectangular lot. An asphalt driveway connects the garage to the street. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}25 m wide by 37 m deep. A front view of the property is shown. 13 refs., 4 figs, 5 tabs.

23130 **(ORNL/RASA—87/87) Results of the radiological survey at 10 Knapp Terrace, Colonie, New York (AL160).** Espegren, M.L.; Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009178/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 10 Knapp Terrace in Colonie, New York was the subject of a radiological investigations initiated July 15, 1986. The residential property consists of a two-story frame house with a separate garage located on a rectangular lot. A gravel/asphalt driveway connects the garage to the street. A diagram of the property showing the approximate boundaries and the 6-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}22 m wide by {approximately}59 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23131 **(ORNL/RASA—87/88) Results of the radiological survey at 8 Highland Avenue, Colonie, New York (AL161).** Espegren, M.L.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009168/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 8 Highland Avenue in Colonie, New York, was the subject of a radiological investigation initiated July 15, 1986. The residential property consists of a two-story frame house and separate, frame shop building located on an irregular lot. An asphalt driveway is located on the property. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the building is shown. The lot included in the radiological survey was {approximately}24 m wide by 35 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23132 **(ORNL/RASA—87/89) Results of the radiological survey at 7 Pansy Street, Albany, New York (AL162).** Espegren, M.L.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009167/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 7 Pansy Street in Albany, New York, was the subject of a radiological investigation initiated July 16, 1986. The residential property consists of a two-story frame and stone house and a separate garage located on an irregular shaped lot. An asphalt driveway connects the garage to the street. A diagram of the property showing the approximate boundaries and the 6-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}30 m wide by 35 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23133 **(ORNL/RASA—87/91) Results of the radiological survey at 7 Maplewood Avenue, Colonie, New York.** Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009213/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 7 Maplewood Avenue in Colonie, New York, was the subject of a radiological investigation initiated May 8, 1986. The residential property consisted of a house and a garage located on a rectangular lot. An asphalt-paved driveway connected the garage with the street. A diagram of the property showing the approximate boundaries and the 4-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}12 m wide by 35.5 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23134 **(ORNL/RASA—87/92) Results of the radiological survey at 21 Lily Street, Albany, New York.** Espegren, M.L.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009214/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 21 Lily Street in Albany, New York (AL164) was the subject of a radiological investigation initiated July 16, 1986. The residential property consists of a two-story frame house located on a rectangular lot. A gravel drive is located on the lot. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}21 m wide by 26 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23135 **(ORNL/RASA—87/93) Results of the radiological survey at 15 Lily Street, Albany, New York (AL165).** Espegren, M.L.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009179/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 15 Lily Street in Albany, New York was the subject of a radiological investigation initiated July 17, 1986. The residential property consists of a one-story frame house located on a rectangular lot. An asphalt driveway connects the house to the street. A diagram of the property showing the approximate boundaries and the 4-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}20 m wide by 26 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23136 **(ORNL/RASA—87/94) Results of the radiological survey at 9 Pansy Street, Albany, New York (AL166).** Espegren, M.L.; Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009175/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 9 Pansy Street in Albany, New York was the subject of a radiological investigation initiated July 17, 1986. The residential property consists of a one-story frame house with a garage located on a rectangular lot. An asphalt driveway connects the house to the street. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}18 m wide by 35 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23137 **(ORNL/RASA—87/95) Results of the radiological survey at 18 Lily Street, Albany, New York (AL167).** Espegren, M.L.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009201/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 18 Lily Street in Albany, New York was the subject of a radiological investigation initiated July 18, 1986. The residential property consists of a two-story frame house located on a rectangular lot. An asphalt driveway connects the house to the street. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}15 m wide by 37 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23138 **(ORNL/RASA—87/96) Results of the radiological survey at 20 Lily Street, Albany, New York (AL168).** Espegren, M.L.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009197/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 20 Lily Street in Albany, New York, was the subject of a radiological investigation initiated July 18, 1986. The residential property consists of a two-story frame house located on a rectangular lot. An asphalt driveway connects the house to the street. A diagram of the property showing the approximate boundaries and the 5-m grid network

established for measurements outside the house is shown. the lot included in the radiological survey was {approximately}14 m wide by 37 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23139 **(ORNL/RASA—87/97) Results of the radiological survey at 22 Lily Street, Albany, New York (AL169).** Espegren, M.L.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009192/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 22 Lily Street in Albany, New York, was the subject of a radiological investigation initiated July 18, 1986. The residential property consists of a two-story frame house located on a rectangular lot. An asphalt driveway connects the house to the street. A diagram of the property showing the approximate boundaries and the 4-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}11 m wide by 30 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23140 **(ORNL/RASA—87/98) Results of the radiological survey at 26 Lily Street, Albany, New York (AL170).** Espegren, M.L.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009413/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 26 Lily Street in Albany, New York, was the subject of a radiological investigation initiated July 18, 1986. The residential property consists of a two-story frame house located on a rectangular lot. An asphalt driveway connects the house to the street. A diagram of the property showing the approximate boundaries and the 10-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}29 m wide by 74 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23141 **(ORNL/RASA—87/99) Results of the radiological survey at 31 Lily Street, Albany, New York (AL171).** Espergren, M.L.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009318/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 31 Lily Street in Albany, New York was the subject of a radiological investigation initiated July 19, 1986. The residential property consists of a one-story frame house located on a rectangular lot. An asphalt driveway connects the house to the street. A diagram of the property showing the approximate boundaries and the 4-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}18 m wide by 25 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23142 **(ORNL/RASA—87/100) Results of the radiological survey at 27 Lily Street, Albany, New York (AL172).** Espegren, M.L.; Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009195/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 27 Lily Street in Albany, New York, was the subject of a radiological investigation initiated July 19, 1986. The residential property consists of a two-story frame house located on a rectangular lot. An asphalt driveway connects the house to the street. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}20 m wide by 34 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23143 **(ORNL/RASA—87/101) Results of the radiological survey at 4/6 Highland Avenue, Colonie, New York (AL173).** Espegren, M.L.; Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009194/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 4/6 Highland Avenue in Colonie, New York, was the subject of a radiological investigation initiated July 20, 1986. The commercial property consists of a one-story building located on an irregular lot. An asphalt driveway surrounds the building. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the building is shown. The lot included in the radiological survey was {approximately}41 m wide by 34 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23144 **(ORNL/RASA—87/102) Results of the radiological survey at 23 Lily Street, Albany, New York.** Espegren, M.L.; Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009211/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 23 Lily Street in Albany, New York (AL174), was the subject of a radiological investigation initiated July 21, 1986. The residential property consists of a two-story frame house located on a rectangular lot. An asphalt driveway connects the house to the street. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}20 m wide by 30 m deep. Front and side views of the property are shown. 13 refs., 5 figs., 5 tabs.

23145 **(ORNL/RASA—87/103) Results of the radiological survey at 30 Frost Place, Albany, New York (AL175).** Espegren, M.L.; Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009414/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 30 Frost Place in Albany, New York, was the subject of a radiological investigation initiated July 21, 1986. The residential property consists of a two-story frame house with a separate garage located on a rectangular lot. An asphalt/gravel driveway connects the garage to the street. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the structures is shown. The lot included in the radiological survey was {approximately}20 m wide by 33 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23146 **(ORNL/RASA—87/104) Results of the radiological survey at 15 Keller Street, Albany, New York (AL176).** Espegren, M.L.; Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009317/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 15 Keller Street in Albany, New York was the subject of a radiological investigation initiated July 22, 1986. The residential property consists of a one-story frame house with an asphalt drive connects the house to the street. A diagram of the property showing the approximate boundaries and the grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}20 m wide by 27 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23147 **(ORNL/RASA—87/105) Results of the radiological survey at 15 Frost Place, Albany, New York.** Espegren, M.L.; Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009215/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 15 Frost Place in Albany, New York, was the subject of a radiological investigation initiated July 22, 1986. The residential property consists of a two-story frame house with a separate garage located on a rectangular lot. An asphalt driveway connects the garage to the street. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately} 16 m wide by 33 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23148 **(ORNL/RASA—87/106) Results of the radiological survey at 12 Frost Place, Albany, New York (AL178).** Espegren, M.L.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009208/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. Radiological surveys were performed at 27 properties by members of the Radiological Survey Activities (RASA) group at Oak Ridge National Laboratory (ORNL) during the period July 13-July 26, 1986. The property at 12 Frost Place in Albany, New York was the subject of a radiological investigation initiated July 22, 1986. The residential property consists of a two-story frame house located on a rectangular lot. An asphalt driveway connects the house to the street. The lot included in the radiological survey was {approximately}13 m wide by 29 m deep. 13 refs., 5 figs., 5 tabs.

23149 **(ORNL/RASA—87/107) Results of the radiological survey at 8 Maplewood Avenue, Colonie, New York (AL180).** Espegren, M.L.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009210/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminate with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 8 Maplewood Avenue in Colonie, New York was the subject of a radiological investigation initiated July 23, 1986. The residential property consists of a one-story frame house located on a rectangular lot. An asphalt driveway connects the house to the street. A diagram of the property showing the approximate boundaries and the 4-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}12 m wide by 35 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23150 **(ORNL/RASA—87/109) Results of the radiological survey at 15 Tremont Street, Albany, New York (AL179).** Espegren, M.L.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009265/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 15 Tremont Street in Albany, New York, was the subject of a radiological investigation initiated July 22, 1986. The residential property consists of a two-story frame house with a separate garage located on an irregular lot. An asphalt driveway connects the garage to the street. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the buildings is shown. The lot included in the radiological survey was {approximately}21 m wide by 33 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23151 **(ORNL/RASA—87/110) Results of the radiological survey at the Crannell property, Railroad Avenue, Colonie, New York (AL217).** Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009193/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium plant in Colonie, New York. The L.W. Crannell property on Railroad Avenue in Colonie, New York was the subject of a radiological investigation initiated June 9, 1987. The property is a heavily wooded, vacant plot of land adjacent to the Niagara Mohawk Power Corporation transmission lines and sub-station. A diagram of the property showing the approximate boundaries and the 15-m grid network established for measurements is shown. The area that was included in the radiological survey was {approximately}62 m wide (varying from 60.5 to 62.5) by 146 m deep. Views of the property showing the south boundary and the nature of the terrain are given. 13 refs., 6 figs., 4 tabs.

23152 **(ORNL/RASA—87/111) Results of the radiological survey at the Niagara-Mohawk property, Railroad Avenue, Colonie, New York (AL218).** Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 29p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009184/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The Niagara-Mohawk property on Railroad Avenue in Colonie, New York, was the subject of a radiological investigation initiated June 11, 1987. This commercial property is an irregularly shaped lot partially occupied by an electric power substation and associated transmission lines. Portions of the property that were swampy and heavily vegetated were inaccessible to the survey team. There are no buildings on the property. A diagram showing the approximate boundaries and the 15-m grid network established for measurements on the property is shown. The lot included in the radiological survey was {approximately}45 m wide by 246 m deep. Two views of the property are shown. 13 refs., 6 figs., 4 tabs.

23153 **(ORNL/RASA—87/112) Results of the radiological survey at 1110 Central Avenue, Albany, New York (AL215).** Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 27p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009183/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 1110 Central Avenue in Albany, New York (AL215) was the subject of a radiological investigation initiated May 4, 1987. This commercial proper-

ty consists of a one-story concrete block office building (Building 1), a one-story concrete block warehouse (Building 2), and four connected storage buildings constructed variously of wood, metal, or concrete block. The structures are situated on an irregularly shaped lot. A diagram of the property showing the approximate boundaries and the 10-m grid network established for measurements outside the buildings is shown. The lot included in the radiological survey was {approximately}45 m wide by 98 m deep. Two views of the property are shown. 13 refs., 6 figs., 5 tabs.

23154 **(ORNL/RASA—87/113) Results of the radiological survey at 6 Orford Street, Colonie, New York (AL213).** Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009170/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 6 Orford Street in Colonie, New York was the subject of a radiological investigation initiated May 2, 1987. The private property consists of a 1{1/2}-story frame house with separate garage on a rectangular lot. An asphalt driveway connects the garage to the street. A diagram of the property showing the approximate boundaries and the 4-m grid network established for measurements outside the buildings is shown. The lot included in the radiological survey was {approximately}16 m wide by 32 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23155 **(ORNL/RASA—87/114) Results of the radiological survey at 1098 Central Avenue, Albany, New York (AL214).** Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009202/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 1098 Central Avenue in Albany, New York (AL214) was the subject of a radiological investigation initiated May 3, 1987. This commercial property consists of a one-story masonry building on an irregularly shaped lot. Most of the lot, with the exception of a landscaped area along the north side, is either asphalt or concrete. A diagram of the property showing the approximate boundaries and the 6-m grid network established for measurements outside the building is shown. The lot included in the radiological survey was {approximately}29 m wide by 50 m deep. Two views of the property are shown. 13 refs., 5 figs., 5 tabs.

23156 **(ORNL/RASA—87/115) Results of the radiological survey at Exit 4, Interstate 90, Albany, New York (AL212).** Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009212/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at Exit 4 between Yardboro Avenue and Interstate 90 in Albany, New York was the subject of a radiological investigation initiated April 27, 1987. The area of survey of the property of the State of New York was the north side of the right-of-way of Interstate 90 (I-90) at Exit 4 (the Slingerlands exit) from the fence along the south side of Yardboro Avenue to the berm of the west-bound lanes of I-90. The survey, starting at the I-90 bridge over Central Avenue continued west for approximately 570 m. The width of the area ranged from {approximately}10 m to 195 m. To perform the survey, a network of sectors forming a grid was established, beginning with a series of basing points measured at {approximately}23-m intervals at the fence along Yardboro Avenue. Sectors were set by projection of lines from the basing points, perpendicular to the fence, to the berm of I-90. Then parallel lines at 23-m intervals were set. 12 refs., 6 figs., 4 tabs.

23157 **(ORNL/RASA—87/116) Results of the radiological survey at 1155-57 Central Avenue, Colonie, New York (AL216).** Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009206/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 1155-57 Central Avenue in Colonie, New York was the subject of a radiological investigation initiated May 7, 1987. This commercial property consists of two separate buildings on an asphalt and concrete-paved lot. A diagram of the property showing the approximate boundaries and the 8-m grid network established for measurements outside the buildings is shown. The larger of the two buildings, Building 1, has been constructed in sections that vary in size, number of levels (1 or 2), and basic materials (frame, concrete block, or meal). Building 2 is a one-story metal structure. The rectangular lot included in the survey was {approximately}33 m wide by 75 deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23158 **(ORNL/RASA—87/117) Results of the radiological survey at 4 Elmhurst Avenue, Colonie, New York (AL219).** Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009177/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 4 Elmhurst Avenue in Colonie, New York was the subject of a radiological investigation initiated June 13, 1987. This private property consists of a one-story frame house with basement on a rectangular lot. An asphalt driveway runs from the rear of the east side of the house to the street. A diagram of the property showing the approximate boundaries and the 4-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}12 m wide by 35 m deep. A front view of the property is shown. 13 refs., 4 figs., 5 tabs.

23159 **(ORNL/RASA—87/118) Results of the radiological survey at 1177 Central Avenue, Colonie, New York (AL130).** Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 38p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009266/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 1177 Central Avenue in Colonie, New York was the subject of a radiological investigation initiated November 8, 1985. The surveyed area includes two of the six parcels of this vicinity property. Overall, the shape is quite irregular and approximately 150 m wide by 260 m deep. The property is functionally multipurpose; part residential, part business, and part wooded area having no structures. A schematic diagram is included which presents the property as individual areas (A through F) of differing apparent primary uses. Areas A, B, C, and D are residential and have been radiologically characterized. This report presents the survey data and evaluations of areas E and F. Two buildings housing a commercial garage (Buildings 1 and 2), and a private residence (Building 3) are situated in area F; area E is wooded. An overall front view of area F is shown. A view of the auto storage area is provided showing the wooded region in the background. Area E is {approximately}71 m wide and 160 m deep; Area F measures {approximately}67 m wide by 69 m deep. Grid networks of 20- and 10-m, respectively, were established for measurements outside the buildings. 17 refs., 9 figs., 7 tabs.

23160 **(ORNL/RASA—88/1) Results of the radiological survey at 1 Maplewood Avenue, Colonie, New York (AL142).** Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009172/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 1 Maplewood Avenue in Colonie, New York (AL142) was the subject of a radiological investigation initiated May 14, 1986. The private property consists of a two-story frame house, a one and one-half-story garage, and separate frame utility building located on a rectangular lot. A concrete drive connects the garage to the street. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the buildings is shown. The lot included in the radiological survey was {approximately}24 m wide by 35.5 m deep. Front and side views of the property are shown. 13 refs., 5 figs., 5 tabs.

23161 **(ORNL/RASA—88/2) Results of the radiological survey at 4 Maplewood Avenue, Colonie, New York (AL143).** Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009189/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 4 Maplewood Avenue in Colonie, New York was the subject of a radiological investigation initiated May 14, 1986. The private property consists of a two-story frame house with attached garage located on a rectangular lot. An asphalt drive connects the garage to the street. A diagram of the property showing the approximate boundaries and the 4-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}13 m wide by 35.5 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23162 **(ORNL/RASA—88/3) Results of the radiological survey at 6 Maplewood Avenue, Colonie, New York (AL144).** Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009196/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 6 Maplewood Avenue in Colonie, New York, was the subject of a radiological investigation initiated May 14, 1986. The private property consists of a two-story frame house and separate garage located on a rectangular lot. An asphalt drive connects the garage to the street. A diagram of the property showing the approximate boundaries and the 4-m grid network established for measurements outside the buildings is shown. The lot included in the radiological survey was {approximately}12 m wide by 35 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23163 **(ORNL/RASA—88/4) Results of the radiological survey at 11 Maplewood Avenue, Colonie, New York (AL145).** Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009203/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 11 Maplewood Avenue in Colonie, New York, was the subject of a radiological investigation initiated May 5, 1986. The private property consists of a one-story frame house and separate garage located on a rectangular lot. An asphalt drive connects the garage to the street. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the buildings is shown. The lot included in the radiological survey was {approximately}23 m wide by 36 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23164 **(ORNL/RASA—88/5) Results of the radiological survey at 10 Maplewood Avenue, Colonie, New York (AL146).** Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009191/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 10 Maplewood Avenue in Colonie, New York was the subject of a radiological investigation initiated May 15, 1986. The private property consists of a 1 1/2-story frame house with attached carport situated on a rectangular lot. A small utility building is located to the rear of the house; and asphalt drive connects the carport to the street. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}25.5 m wide by 35.5 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23165 **(ORNL/RASA—88/6) Results of the radiological survey at 6 Knapp Terrace, Colonie, New York (AL158).** Hall, S.C.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009188/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 6 Knapp Terrace in Colonie, New York, was the subject of a radiological investigation initiated June 10, 1986. The residential property consists of a two-story frame house with a separate garage located on a rectangular lot. An asphalt driveway connects the garage to the street. A diagram of the property showing the approximate boundaries and the 6-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}12 m wide by 57 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23166 **(ORNL/RASA—88/7) Results of the radiological survey at 6 frost place, Albany, New York (AL185).** Espegren, M.L.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009190/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 6 Frost Place in Albany, New York, was the subject of a radiological investigation initiated July 24, 1986. The residential property consists of a two-story frame house with a separate garage located on a rectangular lot. An asphalt driveway connects the garage to the street. A diagram of the property showing the approximate boundaries and the 6-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}18 m wide by 40 m deep. A front view of the property is shown. 13 refs., 4 figs., 5 tabs.

23167 **(ORNL/RASA—88/8) Results of the radiological survey at 8 Elmhurst Avenue, Colonie, New York (AL181).** Espegren, M.L.; Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009181/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium

forming plant in Colonie, New York. The property at 8 Elmhurst Avenue in Colonie, New York, was the subject of a radiological investigation initiated July 23, 1986. The residential property consists of a two-story frame house and a garage located on a rectangular lot. An asphalt driveway connects the garage to the street. A diagram of the property showing the approximate boundaries and the 4-m grid network established for measurements outside the building is shown. The lot included in the radiological survey was {approximately}12 m wide by 35 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23168 **(ORNL/RASA—88/9) Results of the radiological survey at 14 Orford Street, Colonie, New York (AL182).** Espegren, M.L.; Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009185/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. Radiological surveys were performed at 27 properties by members of the Radiological Survey Activities (RASA) group at Oak Ridge National Laboratory (ORNL) during the period July 13--July 26, 1986. The property at 14 Orford Street in Colonie, New York (AL182) was the subject of a radiological investigation initiated July 23, 1986. The residential property consists of a two-story frame house located on a rectangular lot. An asphalt driveway connects the house to the street. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}15 m wide by 34 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23169 **(ORNL/RASA—88/10) Results of the radiological survey at 12 Orford Street, Colonie, New York (AL183).** Espegren, M.L.; Marley, J.L.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009187/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 12 Orford Street in Colonie, New York, was the subject of a radiological investigation initiated July 24, 1986. The residential property consists of a two-story frame house located on a rectangular lot. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}16 m wide by 34 m deep. Front and rear views of the property are shown. 13 refs., 5 figs., 5 tabs.

23170 **(ORNL/RASA—88/11) Results of the radiological survey at 5 Frost Place, Albany, New York (AL184).** Espegren, M.L.; Marley, J.L. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009186/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. The property at 5 Frost Place in Albany, New York (AL184) was the subject of a radiological investigation initiated July 24, 1986. The residential property consists of a two-story frame house located on a rectangular lot. An asphalt driveway connects the house to the street. A diagram of the property showing the approximate boundaries and the 5-m grid network established for measurements outside the house is shown. The lot included in the radiological survey was {approximately}15 m wide by 31 m deep. A front view of the property is shown. 13 refs., 4 figs., 5 tabs.

23171 **(ORNL/RASA—88/12) Results of the radiological survey at the Conrail property south of the Colonie site, Albany, New York (AL141).** Marley, J.L.; Carrier, R.F.; Hall, S.C. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009173/JAW.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York. A section of right-of-way owned by the Consolidated Rail Corporation (Conrail) and located just south of the Colonie site in Albany, New York, was the subject of a radiological investigation initiated May 13, 1986. For ease in reporting results, the surveyed area was divided from west to east into 13 sectors. Sectors 1 through 12 include the right-of-way west of Central Avenue for a distance of {approximately}576 m, and are based on a 50-m grid network established for the precise locating of measurements. The west end of the grid was posited at a utility pole located {approximately}25 m west of the western boundary of the National Lead property. Parallel lines were then set along the baseline (BL) at 50-m intervals, and measurements in sectors 1-12 were made from the utility pole, east to the bridge over Central Avenue. Sectors 1-12 of the surveyed area are bordered on the north by the NL site and by 1100, 1104, and 1110 Central Avenue, and on the south by Yardboro Avenue properties. This portion of the property varies in width from 25 to 55 m. Sector 13 is {approximately}12.5 m wide and extends for {approximately}42 m along a 20-m grid network southeast of the 1095 Central Avenue property. Measurements of sector 13 were made by starting at location 0+00, BL, then west for {approximately}42 m. 13 refs., 7 figs., 6 tabs.

23172 **(ORNL/RASA—88/21) Results of the radiological survey at Grant Avenue Memorial Park (MJ028), Maywood, New Jersey.** Foley, R.D.; Crutcher, J.W.; Carrier, R.F.; Floyd, L.M. (Oak Ridge National Lab., TN (USA)). Feb 1989. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008632/JAW.

The property discussed in this report and properties in its vicinity contaminated with residues from the former Maywood Chemical Works (MCW) were included as a decontamination research and development project under the DOE Formerly Utilized Sites Remedial Action Program. As part of this project, DOE is conducting radiological surveys in the vicinity of the site to identify properties contaminated with residues derived from the MCW. The principal radionuclide of concern is thorium-232. The radiological survey discussed in this report is part of that effort and was conducted, at the request of DOE, by members of the Measurement Applications and Development Group of Oak Ridge National Laboratory. A radiological survey of the property at Grant Avenue Memorial Park, Maywood, New Jersey, was conducted during 1987.

23173 **(ORNL/RASA—88/102) Preliminary site survey report for the Sacandaga site, Glenville, New York.** Cottrell, W.D.; Foley, R.D.; Carrier, R.F. (Oak Ridge National Lab., TN (USA)). Mar 1989. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009299/JAW.

Of the numerous original buildings, only Building P, the Critical Assembly Building, remains standing. Front and rear views of the small, concrete block building are shown. The remaining structure is situated on {approximately}51 acres of land, most of which is covered by a heavy growth of trees and brush. An abundance of rubbish and dismantled structural materials is strewn throughout the site. It is estimated that the total inventory of radioactive materials in the site included {approximately}300 kg of uranium in the form of solid metal discs, {approximately}8 mg of plutonium on platinum discs covered with plastic, and {approximately}3 mg of radium sealed in a radium/beryllium source. Both ^{238}U and ^{235}U in solid metal form were used in experiments for breeder reactor studies. This type of assessment typically involves a two-stage process. The first part consists of a site visit and preliminary scoping survey to verify that no radiological hazard exists at a spe-

cific site, and to collect sufficient data to plan the second part of the process--the more comprehensive radiological survey. The preliminary radiological scoping survey discussed in this report was conducted. Compared to the large size of the property, the survey was limited in scope, including only the 5--6 acres enclosed within the fence and concentrating on those areas having the greatest possibility of containing residual radioactive material. 3 refs., 8 figs., 3 tabs.

23174 **(ORNL/TM—11110) Results of the radiological survey at Sumitomo Machinery Corporation of America, 7 Malcolm Avenue, Teterboro, New Jersey (TJ001).** Foley, R.D.; Floyd, L.M. (Oak Ridge National Lab., TN (USA)). Feb 1989. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009340/JAW.

A radiological survey of the commercial property at 7 Malcolm Avenue, Teterboro, New Jersey, was conducted on November 12--20, 1986. Samples of the soil surface were taken for further analyses during this time. Conversations with property owners revealed that originally this site was part of a single property of approximately 107 acres owned entirely by the Bendix Aerospace Corporation. During this period of total property ownership, Bendix was licensed by the Nuclear Regulatory Commission to use thorium in on-site Navy/Bendix process. Around 1976, the property was subdivided into three parcels, and one parcel of about 7 acres was purchased by Sumitomo Corporation. 5 refs., 3 figs., 5 tabs.

23175 **(ORNL/TM—11111) Results of the radiological survey at Allied Bendix Aerospace Corporation, Industrial and Williams Avenues, Teterboro, New Jersey (TJ002).** Foley, R.D.; Floyd, L.M. (Oak Ridge National Lab., TN (USA)). Feb 1989. Contract AC05-84OR21400. 19p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009342/JAW.

A radiological survey of the commercial property at Industrial and Williams Avenues, Teterboro, New Jersey, was conducted on November 17--18, 1986. Samples of the soil surface were taken for further analyses during this time. Prior to 1976, Bendix was licensed by the Nuclear Regulatory Commission to use thorium in an on-site Navy/Bendix process. 4 refs., 3 figs., 4 tabs.

23176 **(ORNL/TM—11118) Results of the radiological survey at Metpath Incorporated, 1 Malcolm Avenue, Teterboro, New Jersey (TJ003).** Foley, R.D.; Floyd, L.M. (Oak Ridge National Lab., TN (USA)). Feb 1989. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009341/JAW.

A radiological survey of the commercial property at 1 Malcolm Avenue, Teterboro, New Jersey, was conducted during 1986 and 1988. The survey and sampling of the ground surface over a major portion of the property were carried out. An unused parking area was surveyed. Conversations with property owners revealed that originally this site was part of a single property of approximately 107 acres owned entirely by the Bendix Aerospace Corporation. During this period of total property ownership, Bendix was licensed by the Nuclear Regulatory Commission to use thorium in an onsite Navy/Bendix process. Around 1976, the property was subdivided into three parcels, and one parcel of about 30 acres was purchased by Metpath Incorporated. Subsequent to this purchase, Metpath leased the General Engineering Test Building back to Bendix Aerospace, the present occupants of the building. 4 refs., 5 figs., 4 tabs.

23177 **(PNL-SA—16538) Monitoring for potential environmental problems at a nuclear research facility at Hanford, Washington, USA.** Gray, R.H. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1989. Contract AC06-76RL01830. 15p. (CONF-890223—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008246/JAW.

From Envirotech Vienna '89; Vienna, Austria (20 Feb 1989).

Objectives are to detect and assess potential impacts of site operations on air, surface and ground water, foodstuffs, fish, wildlife, soil and vegetation. Data from monitoring efforts are used to calculate the overall radiological dose to humans working onsite or residing in nearby communities. In 1987, measured Hanford Site perimeter concentrations of airborne radionuclides were below applicable DOE and Environmental Protection Agency guidelines. Tritium and nitrate continued to be the most widespread constituents in onsite ground water. Chromium, cyanide, fluoride, and carbon tetrachloride were found in ground-water wells near operating areas. Concentrations of radionuclide and nonradiological water quality in the Columbia River were in compliance with applicable standards. Foodstuffs irrigated with river water taken downstream of the Site showed low levels of radionuclides that were similar to concentrations found in foodstuffs from control areas not irrigated with Columbia River water. Low levels of ^{90}Sr and ^{137}Cs in some onsite wildlife samples were typical of those attributable to worldwide fallout as were concentrations of radionuclides found in soils and vegetation from onsite and offsite locations. The calculated dose potentially received by a maximally exposed individual (i.e., based on hypothetical assumptions for all routes of exposure) in 1987 (0.05 mrem/yr) was similar to that calculated for 1985 and 1986. 29 refs., 5 figs.

5104 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 23037

5106 Regulations

23178 **(PNL—6755) Guidelines for Hanford Site implementation of the National Environmental Policy Act.** King, S.E. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1989. Contract AC06-76RL01830. 98p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008963/JAW.

The National Environmental Policy Act (NEPA) environmental review process is mandatory for federal agencies. Understanding and complying with NEPA is extremely important to successfully planning and implementing programs at the Hanford Site. This report is intended to help planners and decision makers understand NEPA by describing the NEPA process as it is outlined in NEPA, in regulations, and in guidance information. The requirements and guidance documents that set forth the NEPA process are discussed. Some of the major NEPA concepts and issues are also addressed. This report is intended to be used as a general road map through the maze of NEPA requirements and guidance to ensure that Hanford Site activities are conducted in compliance with NEPA. Enhanced knowledge of the NEPA process is expected to increase the ability of the Hanford Site to work with regulators, interested parties and the public to ensure that the potential environmental impacts of DOE activities are fully considered at the Hanford Site. In addition, an enhanced understanding of NEPA will help project and program managers to integrate NEPA compliance requirements with program planning. 43 refs., 6 figs., 3 tabs.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 23080, 23082, 23227

23179 **(GKSS—88/E/52) Application of two- and three-dimensional high resolving models to a small section of the Elbe estuary - a comparative study.** Krohn, J.; Lobmeyr, M. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1988. 46p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757382/JAW.

Detailed hydrographic observations have been used to calibrate and compare two- and three-dimensional numerical models. They are described including a comprehensive outline of the numerical algorithms. Various kinds of open boundary types are investigated yielding some uncertainties connected with tide gauge data. Compared with the data, the three-dimensional models produces slightly more realistic results than the two-dimensional one. (orig.) With 24 figs.

23180 **(IPEN-PUB—217) Bed load determination in Parana river by radioactive tracer technique.** Aoki, P.E.; Enokihara, C.T.; Rocca, H.C.C.; Bittencourt, A.V.L. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). Oct 1988. 29p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705779/JAW.

Radioactive tracing technique with marked sand was employed to evaluate the bottom sediment drag of Parana river, near the future site for the "Ilha Grande" Dam in Guaira City (State of Parana). /sup 198/Au radioisotope was employed and measurements had been performed for a period of fifteen days. A bed load rate of 952,3 t/day was obtained for a laminar layer of 0,33 m mean thickness and 1.65 m/day mean velocity.

23181 **(TR-EL—82-4/82(11.95)) Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest): Pismo clam.** Shaw, W.N.; Hassler, T.J. (Humboldt State Univ., Trinidad, CA (USA). Fred Telonicher Marine Lab.; Humboldt State Univ., Arcata, CA (USA). California Cooperative Fishery Research Unit). Feb 1989. 20p. (BR—82(11.95)). OSTI - US Fish and Wildlife Service, 1010 Gause Blvd., Slidell, LA 70458. Order Number TI89008636/JAW.

Species profile are literature summaries of the taxonomy, morphology, distribution, life history, and environmental requirements of coastal aquatic species. They are prepared to assist in environmental impact assessment. The Pismo clam (Tivela stultorum) supports an important sport fishery in the Pacific Southwest region, but has no present commercial importance. This review describes the life history (spawning, eggs, and larval stages, postlarvae and juveniles, maturity, and life-span), growth characteristics, former commercial and sport fisheries, ecological role, and environmental requirements. 30 refs., 4 figs., 3 tabs.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 23061, 23063, 23084

23182 **(ORNL/M—713) Mercury assessment for water and sediment in Oak Ridge National Laboratory streams.** Taylor, F.G. Jr. (Oak Ridge National Lab., TN (USA)). Mar 1989. Contract AC05-84OR21400. 32p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008974/JAW.

An assessment plan was implemented in compliance with the Clean Water Act and the Oak Ridge National Laboratory's (ORNL) National Pollutant Discharge Elimination System (NPDES) permit to identify, locate, and minimize all sources of mercury contamination in ORNL discharges to the aquatic environment. This plan was designed to identify sources of mercury from past operations and spills through a review of file records and personal interviews. A network of monitoring and sampling stations, based on knowledge of mercury deposits in receiving streams, knowledge of mercury discharges from pipes to streams, and a review of chemical data from previous contaminant surveys, was established for sample collection. The plan was designed to assess the potential for the metal reaching surrounding streams and rivers by placement of sampling sites relative to potential contaminant movement from areas of deposition. This summary report describes appropriate sampling and analytical procedures, defines the database management system, provides for chain-of-custody, Quality Assurance (QA), and presents contaminant concentration data for 1988. 11 refs., 3 figs., 10 tabs.

23183 **(PNL-SA—15870) The need to update ground water pollution control strategies: A technical basis and historical perspective.** Nelson, R.W. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1988. Contract AC06-76RL01830;AC04-76DP00789. 37p. (CONF-881166—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009381/JAW.

From Symposium on advances in ground-water hydrology; Tampa, FL, USA (16 Nov 1988).

The last half century of technical literature in ground water quality hydrology provides a historical perspective for better evaluation of today's subsurface contamination problems. The literature emphasizes that three interrelated variables are required to evaluate the environmental consequences of any ground water contamination problem: (1) the contaminant quantities or concentrations reaching the accessible environment, (2) the arrival times of the contaminants at the accessible biosphere, and (3) the outflow locations of the contaminants to the biosphere. Each of these three variables is functionally interdependent on the other two. This specific interdependence between the three variables must be known for a particular problem in order to evaluate the long-term environmental consequences of that specific problem. Today's ground water quality regulations or control strategies consider one or perhaps two of these variables individually. Seldom, if ever, are all three considered, and regulatory emphasis on their basic functional interdependence is essentially nonexistent. Such omissions in control standards are unacceptable because they lead to unsound ground water quality control decisions that are wasteful, unnecessarily expensive, time-consuming, and even environmentally dangerous. 62 refs., 6 figs.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 21832, 22113, 22114, 22156, 22184, 22242, 22247, 23076, 23106, 23107, 23177

23184 **(INIS-mf—11915) He isotope concentrations in groundwater - measurement and interpretation.** Weise, S. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Physik). 4 Dec 1986. 165p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88757365/JAW.

While up to now metrological problems obstructed the use of /sup 3/He as hydrological tracer, the /sup 4/He content of groundwater samples presented difficulties for interpretation. In the framework of this study, first of all, metrological problems in connection with the determination of helium isotope contents in groundwater samples were solved. Then the possibilities and limits of dating measured /sup 3/He values could be determined. For the interpretation of the age of /sup 4/He contents extended model concepts were used.

23185 **(OEVS-Mitteilung—2/1988) Austrian Radiation Protection Association - spring convention 1985. Spring convention 1985.** Tschurlovits, M. (Atominstitut der Oesterreichischen Universitaeten, Vienna) (ed.). (Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna). 1988. 96p. (In German, English). (CONF-8505399—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88706267/JAW.

From Austrian Radiation Protection Association - spring convention 1985; Vienna, Austria (1 May 1985).

Seven papers on the distribution of man-made and natural radionuclides in the (mostly aquatic) environment in Belgium, Netherlands, Hungary and Austria are presented. (qui).

23186 (OEVS-Mitteilung—2/1988, pp 1-14) **Estimate of the radiation burden from civil-source radionuclides fed into the Maas and its tributary rivers.** Bayer, A.; Gouvras, G.; Kirchmann, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.); Kommission der Europaeischen Gemeinschaften, Luxemburg (Luxembourg); Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1988. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88706267/JAW. (CONF-8505399—).

From Austrian Radiation Protection Association - spring convention 1985; Vienna, Austria (1 May 1985).

For the year 1980 data on the flow of 15 radionuclides from nuclear facilities, hospitals and laboratories into the Maas and its tributaries were assessed and their concentration in 30 media calculated by the KIRMES'85 code. Reference was made to naturally occurring radionuclides and those from atomic-weapons tests. Furthermore 23 exposition paths to the population were considered and doses calculated. The results are: for a farmer, 1,5x10/sup -2/ mSv/a from civil sources against 8,1x10/sup -2/ mSv/a from natural and atomic-weapons nuclides. Similarly, the collective dose is 1,4 man Sv/a from civil sources against 12 man Sv/a from the reference. 3 refs., 2 tabs. (qui).

23187 (OEVS-Mitteilung—2/1988, pp 15-26) **Exposure of the Hungarian population from the radionuclides contained in the Danube river.** Sztanyik, L.B.; Stur, D.; Kerekes, A. ('Frederic Joliot-Curie' National Research Institute for Radiobiology and Radiohygiene, Budapest (Hungary)). 1988. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88706267/JAW. (CONF-8505399—).

From Austrian Radiation Protection Association - spring convention 1985; Vienna, Austria (1 May 1985).

Data taking and data processing methods used to estimate the dose commitment of the population from the Danube river are described, for the man-made isotopes tritium, strontium 90 and cesium 137, as compared to the natural isotopes potassium 40 and radium 226. Doses from strontium 90 and cesium 137 are an order of magnitude lower than those from the natural isotopes. This is not true for tritium. The dose from Danube is estimated to be 15 μSv/a. 7 refs., 1fig., 3 tabs. (qui).

23188 (OEVS-Mitteilung—2/1988, pp 55-63) **Activity concentration in the Austrian Danube reach between 1977 and 1985 and derived quantities.** Tschurlovits, M.; Buchtela, K.; Unfried, E. (Atominstitut der Oesterreichischen Universitaeten, Vienna). 1988. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88706267/JAW. (CONF-8505399—).

From Austrian Radiation Protection Association - spring convention 1985; Vienna, Austria (1 May 1985).

Measurements of the activity concentration in the water of the Danube river are described, which were hitherto not carried out in this density. Due to the large number of the data, a well founded view of the radioecological behavior in the Austrian reach of the Danube river was found. 4 figs., 2 tabs.

23189 (OEVS-Mitteilung—2/1988, pp 65-74) **Measurement of radon in water.** Hofmann, W.; Daschil, F. (Salzburg Univ. (Austria). Inst. fuer Allgemeine Biologie, Biochemie und Biophysik). 1988. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88706267/JAW. (CONF-8505399—).

From Austrian Radiation Protection Association - spring convention 1985; Vienna, Austria (1 May 1985).

Different techniques for the measurement of the radon content in drinking water are compared. Based on our own measurements we discuss the typical range of the radon content in a municipal drinking water system (Salzburg). It could be shown that the radon concentrations vary with time, dependent on meteorological and hydrological factors. The release of radon into the indoor air due to daily water consumption can cause an additional radiation hazard from inhaled radon decay products. 10 refs., 3 figs.

23190 (OEVS-Mitteilung—2/1988, pp 75-96) **Environmental tritium in Central Europe 1965 - 1985.** Rank, D. (Bundesversuchs- und Forschungsanstalt Arsenal, Vienna (Austria)). 1988. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88706267/JAW. (CONF-8505399—).

From Austrian Radiation Protection Association - spring convention 1985; Vienna, Austria (1 May 1985).

From the onset of nuclear weapon tests in the atmosphere, the tritium released determined the tritium content in the rainfall and therefore in the environment. There are some indications of the influence of nuclear industry on the tritium content of the rain. In Central Europe the radon content declined steadily since 1963 and was about 2,5 Bq/kg in 1985 which is the threefold of the natural level. In some ground and surface waters the concentration is higher, depending on the water age. In the annual rings of trees and in the river sediments the temporal development of the environmental tritium is recorded. 17 refs., 8 figs., 2 tabs. (qui).

23191 **(SAAS—366) On the simulation of subsurface migration of radionuclides.** Angermann, L. (Technische Univ., Dresden (German Democratic Republic)). (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1989. 36p. (In German). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706274/JAW.

The consequences of the migration of contaminants through the groundwater flow system can be estimated by means of the analytical solutions of the corresponding initial-boundary value problems. The paper states analytical solutions of some selected problems which have not been considered in this form as yet and it describes a conception for the reliable computation of the required function values.

23192 **(TR-EL—82-4(11.86)) Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Northwest): Sea-run cutthroat trout.** Pauley, G.B.; Oshima, K.; Bowers, K.L.; Thomas, G.L. (Washington Univ., Seattle (USA). Cooperative Fishery Research Unit). Jan 1989. 28p. OSTI - US Fish and Wildlife Service, 1010 Gause Blvd., Slidell, LA 70458. Order Number TI89008886/JAW.

Species profiles are literature summaries of the taxonomy, morphology, range, life history, and environmental requirements of coastal aquatic species. They are designed to assist with environmental impact assessments. The sea-run cutthroat trout (Salmo clarki clarki) is anadromous and is found in most coastal streams from Southeast Alaska to Northern California. A thriving sport fishery exists both in these freshwater streams and in protected marine waters. Many of the small streams containing cutthroat trout can be adversely altered by poor timber operations. Optimum temperature for incubating is 10 to 11 {degree}C and eggs hatch in 28-40 days. Optimum temperature for juveniles is 15{degree}C and ability to swim is lost at about 28{degree}C. Adults prefer fairly slow-moving water with plenty of cover. Spawning occurs in small diameter gravel. Like steelhead trout, they may return from saltwater to spawn several times. 102 refs., 4 figs.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 22216

53 Social And Economic Studies

REFER ALSO TO CITATION(S) 22191

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

REFER ALSO TO CITATION(S) 23229

5502 Biochemistry

REFER ALSO TO CITATION(S) 21921, 21922, 23021, 23200, 23242

23193 **(ANL/PPRNT—89-100) The dual role of antibody in idiotype networks: Structural implications.** Schiffer, M.; Kohler, H.; Kieber-Emmons, T.; Stevens, F. (Argonne National Lab., IL (USA); Roswell Park Memorial Inst., Bethesda, NY (USA). Dept. of Molecular Immunology). 8 Apr 1986. Contract W-31109-ENG-38. 17p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008444/JAW.

One direct explanation for this phenomenon requires that the spectrum of Ab combining sites comprises a complete set of geometric conformations and that the idiotype network, or portions of it, must be described as an alternating series of "negative" and complementary "positive" structures. Until recently, no experimental support for the existence of "positive" binding sites existed, suggesting the potential usefulness of a formulation of idiotype networks that places no physical constraints on the shapes of the Ab combining sites. In this report, we analyze Jerne's formulation from the perspective of Ab structure. We discuss certain points of ambiguous structural technology that we perceive as contributing confusion in the description of idiotype network relationships and mechanisms. In so doing, we attempt to contribute no new nomenclature to the growing network of jargon. 36 refs., 2 figs.

23194 **(ANL/PPRNT—89-169) A fraction collector designed specifically for DNA alkaline elution studies.** Eisler, W.J.; Peak, M.J. (Argonne National Lab., IL (USA)). 1989. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008354/JAW.

A fraction collector designed specifically to be compatible with the analytical techniques of alkaline and neutral elution of DNA from carcinogen-treated cells is described. The collector permits collection of as many as twenty elution experiments simultaneously,directly into standard- or small-size scintillation vials contained in the manufacturer's shipping carton. New techniques for measuring DNA changes in cells exposed to genotoxic agents by examining its elution profile from membrane filters by neutral or alkaline solutions have recently become generally used. Elution techniques are considerably more sensitive than classical methods of sedimentation or extractability for assaying DNA damages such as backbone scissions or DNA to protein crosslinks. The method requires the use of many filter holders in parallel, from which the radioactive DNA samples are pumped and collected, usually in a commercial fraction collector. Depending upon the fraction collector available, the number of liquid samples that can be collected simultaneously may be limited. These aliquots are usually then all manually transferred to scintillation vials for counting. We have constructed a fraction collector specifically designed for the operating versatility of the various requirements of DNA elution techniques. It is built to collect the DNA samples directly into to the scintillation vials, thereby obviating time consuming transfer procedures. It also eliminates the possibility of operator error in the transfer process, thereby increasing reliability. 2 refs., 3 figs.

23195 **(DOE/ER/13374—1) Regulation and genetic organization of hydrogenase: Progress report, 1 June 1985--31 March 1986.** Krasna, A.I. (Columbia Univ., New York (USA). Coll. of Physicians and Surgeons). [1989]. Contract FG02-85ER13374. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008461/JAW.

The experiments concentrate on development of screening methods and cloning of the hydrogenase gene. The first method used to distinguish between hydrogenase-negative and hydrogenase-positive cells of E. coli is to measure the ability of colonies of the cells on agar plates (with complex or minimal media with or without antibiotics) to reduce the dye methyl viologen with H_2 gas. The presence of hydrogenase activity in the positive colonies is confirmed by growth in liquid media. 3 figs., 2 tabs.

23196 **Electronic spectrum of adenine by electron impact methods.** Dillon, M.A.; Tanaka, H.; Spence, D. (Argonne National Lab., IL (USA)). *Radiation Research;* **117**: No. 1, 1-7(Jan 1989).

The electron energy loss spectrum of adenine has been recorded over an excitation energy range of approximately 3-22 eV for scattering angles of 3 degrees and 6 degrees. In addition to reporting accurate vapor phase peak positions, the present work supports the long-held contention that the group of peaks in the 6- to 10-eV range belong to transitions that originate from valence pi orbitals. In the vapor phase spectrum, a Rydberg transition corresponding to an n----3s excitation is readily observed with a term value of 3.45 eV relative to the first long-pair ionization potential.

23197 **Physiological importance of the heterodisulfide of coenzyme M and 7-mercaptoheptanoylthreonine phosphate in the reduction of carbon dioxide to methane in Methanobacterium.** Bobik, T.A.; Wolfe, R.S. (Univ. of Illinois, Urbana (USA)). *Proceedings of the National Academy of Sciences of the United States of America;* **85**: No. 1, 60-63(Jan 1988). Contract FG02-87ER13651.

The heterodisulfide of the two coenzymes 2-mercaptoethanesulfonic acid (coenzyme M, HS-CoM) and N-(7-mercaptoheptanoyl)threonine O^3-phosphate (HS-HTP) increased the rate of CO_2 reduction to methane by cell extracts 42-fold. The stimulation resulted from activation of the initial step of methanogenesis, the production of formylmethanofuran from methanofuran and CO_2. These results establish a role for this heterodisulfide (CoM-S-S-HTP) in the reduction of CO_2 to formylmethanofuran. Evidence indicates that CoM-S-S-HTP is the labile intermediate that accounts for the coupling of the reduction of 2-(methylthio)ethanesulfonic acid by the methylreductase to formylmethanofuran biosynthesis, the RPG effect. The heterodisulfide was found to be labile in cell extracts due to enzyme-catalyzed reduction and possibly thiol-disulfide exchange.

23198 **Proceedings of the international symposium on quantum biology and quantum pharmacology.** Loewdin, P.O.; Oehrn, N.Y.; Sabin, J.R.; Zerner, M.C. (eds.). New York, NY; John Wiley and Sons, Inc. (1988). 323p. John Wiley and Sons, Inc., 605 Third Avenue, New York, NY 10158. Contract FG05-88ER60646.

From International symposium on quantum biology and quantum pharmacology; Marineland, FL, USA (12 Mar 1988).

The document contains 22 papers on various aspects of quantum chemistry in biology. Topics include: the structure and function of photoreceptors, molecular design, simulation of proteins and nucleic acids using quantum mechanics and molecular mechanics, microscopic electrostatics and hydration phenomena, protein foldings, and protein relaxation. (TEM)

23199 **Quantitation of water in membranes by neutron diffraction and X-ray techniques.** Knott, R.B.; Schoenborn, B.P. (Applied Physics Div., Australian Atomic Energy Commission, Sutherland, NSW 2232 (AU); Center for Structural Biology, Dept. of Biology, Brookhaven National Lab., Upton, NY (US)). pp 217-229 of Biomembranes. Packer, L. San Diego, CA; Academic Press Complimentary Copy Coordinator, Marketing Dept. (1986).

Present understanding of the ubiquitous membrane places significant importance on the role of water in membrane structure and function. The interaction of water with membranes and membrane components has been studied in some detail by a variety of techniques. Often more detailed information on the water associated with the membrane is required. The unique ability of neutron diffraction techniques to image the water directly, coupled with information from complementary X-ray diffraction analysis, permits a detailed study of the membrane water, including a quantitative analysis in many situations. The application of these techniques is now well established, and a number of excellent reviews on neutron diffraction and X-ray diffraction methods are available. To obtain sufficient experimental data for an estimate of the quantity of water in the membrane system, stacks of membranes in a well-ordered state are required. Certain biological membranes occur naturally in stacks and can be studied intact. Membrane fragments or large

membrane vesicles can be stacked artificially to give an adequate diffraction pattern, and highly oriented multibilayers of pure lipids or lipid/proterin mixture can be formed by evaporative deposition.

5503 Cytology

REFER ALSO TO CITATION(S) 23021, 23199

5504 Genetics

REFER ALSO TO CITATION(S) 23195

23200 **(DOE/ER/13204—T2) Genetics of thermophilic bacteria: Progress report, May 1, 1986--June 30, 1988.** Welker, N.E. (Northwestern Univ., Evanston, IL (USA)). 1988. Contract FG02-84ER13204. 12p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009051/JAW.

Efficient and reliable protoplasting, regeneration and fusion techniques have been established for a prototrophic strain of Bacillus stearothermophilus. A variety of auxotrophic mutants and a restriction-deficient mutant were isolated and protoplast fusion was used to construct isogenic strains and for chromosomal mapping. Two linkage groups (hom thr and his gly pur-1) were established using this system. The order of the markers is similar to analagous markers on the Bacillus subtilis chromosome. We have evidence that this genetic exchange system can be used for linear chromosomal DNA transformation of protoplasts. Investigations have recently been initiated to develop a transducing system in this strain. Attempts to introduce a thermophile plasmid into strain NUB36 by transformation of protoplasts or protoplast fusion were unsuccessful. We think that the lack of success encountered in these studies is because this plasmid is not stably maintained at high temperature and/or is incompatible with the cryptic plasmids contained in this strain. This is the first report of a reliable genetic exchange system in B. stearothermophilus. This system can be used for the genetic analysis of this organism and for molecular cloning. The development of a host-vector system for cloning in B. stearothermophilus will make it possible to clone genes encoding cellulose hydrolysis, alcohol formation, or methane production. In addition, information gained from the genetic analysis of thermophilic bacilli may be of value in developing genetic systems in thermophilic eubacteria and archaebacteria. 3 tabs.

23201 **(LA-UR—89-817) Simulation and analysis of physical mapping.** Sirotkin, K.; Loehr, J.J. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 22p. (CONF-881276—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009399/JAW.

From Interface between computational science and nucleic acid sequencing; Santa Fe, NM, USA (12 Dec 1988).

The current talk involves objects smaller than those that are macro-restriction mapped but larger than the bases that are sequenced. Specifically, we describe simulations of the alignment of recombinant lambdoid and cosmid clones by fingerprinting methods. The purpose of the simulation is to compare methods, as realistically as desired, while preparing for the analysis of actual physical mapping data. Furthermore, we will eventually begin to "submit" data to the Human Genome Information Resource (HGIR) to exercise its database. A simulation has advantages over a formal mathematical analysis. Not only can a simulation be as realistic as desired (for example by using actual sequences from GenBank{trademark}) but if desired properly, when finished much of the code could be used on actual data. Furthermore, a simulation can be designed to utilize any degree of parameterization, while analyses usually must make simplifying assumptions to minimize the number of parameters. For example, the way this simulation is designed one could, by simply adding a short module, mimic rearrangements that might occur during cloning in order to discover the effect that they would have on the contig generating algorithms and to learn how to recognize and deal with such rearrangements. This talk describes the structure and announces the availability of the code for the simulation modules. We tested the method for aligning clones based upon oligonucleotide hybridizing sites comparing its efficacy on actual human DNA sequences from GenBank to its efficacy on random, completely uncorrelated sequence. Surprisingly, its performance was about the same on both sequences.

23202 **Cloning of the chromosome translocation breakpoint junction of the t(14;19) in chronic lymphocytic leukemia.** McKeithan, T.W.; Rowley, J.D.; Shows, T.B.; Diaz, M.O. (Univ. of Chicago, IL (USA)). *Proceedings of the National Academy of Sciences of the United States of America;* **84**: No. 24, 9257-9260(Dec 1987). Contract FG02-86ER60408.

The authors' laboratory has reported that t(14;19)(q32;q13.1) is a recurring translocation in the neoplastic cells of patients with chronic lymphocytic leukemia. In the present study, they have analyzed the leukemic cells from one such patient with probes from the immunoglobulin heavy-chain locus, which is present on band q32 of chromosome 14. Using a probe for the α constant-region gene segments, they detected a rearranged band by Southern blot analysis. This rearranged band was cloned and mapped. A subclone free of repetitive sequences was shown to be from chromosome 19 by analysis of human-mouse somatic cell hybrids, confirming that the rearranged band contains the translocation breakpoint junction. This probe may be used to identify a gene on chromosome 19 adjacent to the breakpoint that can contribute to the malignant development of B lymphocytes.

5505 Metabolism

REFER ALSO TO CITATION(S) 21920

5506 Medicine

REFER ALSO TO CITATION(S) 22121, 23198, 23694

23203 **(LA-UR—89-912) Conceptual design of an RFQ accelerator-based neutron source for boron neutron-capture therapy.** Wangler, T.P.; Stovall, J.E.; Bhatia, T.S.; Wang, C.K.; Blue, T.E.; Gahbauer, R.A. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 4p. (CONF-890335—23). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009286/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

We present a conceptual design of a low-energy neutron generator for treatment of brain tumors by boron neutron capture theory (BNCT). The concept is based on a 2.5-MeV proton beam from a radio-frequency quadrupole (RFQ) linac, and the neutrons are produced by the $^{7}Li(p,n)^{7}Be$ reaction. A liquid lithium target and modulator assembly are designed to provide a high flux of epithermal neutrons. The patient is administered a tumor-specific ^{10}Be-enriched compound and is irradiated by the neutrons to create a highly localized dose from the reaction $^{10}B(n,\alpha)^{7}Li$. An RFQ accelerator-based neutron source for BNCT is compact, which makes it practical to site the facility within a hospital. 11 refs., 5 figs., 1 tab.

23204 **(LBL—26472) Neurosurgical applications of ion beams.** Fabrikant, J.I.; Levy, R.P.; Phillips, M.H.; Frankel, K.A.; Lyman, J.T. (Lawrence Berkeley Lab., CA (USA)). Dec 1988. Contract AC03-76SF00098. 36p. (CONF-881151—54). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008176/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

The program at Donner Pavilion has applied nuclear medicine research to the diagnosis and radiosurgical treatment of life-threatening intracranial vascular disorders. Stereotactic heavy-charged-particle Bragg peak radiosurgery, using narrow beams of heavy ions, demonstrates superior biological and physical characteristics in brain over x- and γ-rays, because of improved dose distribution in the Bragg Peak, and sharp lateral and distal borders and less scattering of the beam. Examination of CNS tissue response and alteration of cerebral blood-flow dynamics related to heavy-ion Bragg peak radiosurgery is carried out using three-dimensional treatment planning and quantitative imaging utilizing cerebral an-

giography, computerized tomography (CT), magnetic resonance imaging (MRI), cine- CT, xenon x-ray CT, and positron emission tomography (PET). Also under examination are the physical properties of narrow heavy-ion beams for improving methods of dose delivery and dose distribution and for establishing clinical RBE/LET and dose-response relationships for human CNS tissues. Based on the evaluation and treatment with stereotactically directed narrow beams of heavy charged particles of over 300 patients, with cerebral angiography, CT scanning, and MRI and PET scanning of selected patients, plus extensive clinical and neuroradiological followup, it appears that stereotactic charged-particle Bragg peak radiosurgery obliterates intracranial arteriovenous malformations or protects against rebleeding with reduced morbidity and no mortality. 9 refs., 11 figs.

23205 **Comparison of 3-D tomographic algorithms for vascular reconstruction.** Rougee, A.; Saint-Felix, D.; Hanson, K.M. (THOMSON-CGR, 283 R. de la Miniere, 78530 - Buc (FR); Los Alamos National Lab., MS P940, Los Alamos, NM (US)). pp v of Medical Imaging II. Schneider, R.H.; Dwyer, S.J. III. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1988). (CONF-880153—).

From Medical imaging II: image data management and display; Newport Beach, CA, USA (31 Jan 1988).

The authors make a comparison of the performances of various three-dimensional reconstruction algorithms for situations where only few conic projections of a vascular tree are available. This problem is ill-posed and prior information must therefore be used to regularize the solution. The discussion is restricted to methods that are able to handle the sparseness and the non-negativity that characterize a iodinated vascular structure: the Extreme Value Technique and related methods, and the Algebraic Reconstruction Technique. The results led the authors to derive a new method based on a two step detection-estimation scheme.

5507 Microbiology

REFER ALSO TO CITATION(S) 22262

23206 **(DOE/PC/79863—T17) Microbial removal of organic sulfur from coal (bacterial degradation of sulfur-containing heterocyclic compounds): Final report, March 1--December 31, 1987.** Klubek, B.; Clark, D. (Southern Illinois Univ., Carbondale (USA)). Mar 1988. Contract FC22-87PC79863. 21p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008368/JAW.

The presence of levels of sulfur in coal is a major source of air pollution and considerable efforts are being made to devise a cost-effective way of removing it. One promising method is microbial desulfurization. Almost all of the inorganic sulfur can be removed from coal by the bacteria Thiobacillus or Sulfolobus, which convert sulfide to sulfate but leave the organic sulfur untouched. If strains of bacteria are developed which remove organic sulfur from coal and are used in conjunction with inorganic sulfur-oxidizing bacteria, the result should be an effective desulfurization method. We are using two approaches to develop bacteria which remove organic sulfur. One method is to mutate a laboratory species, Escherichia coli, an organism which is genetically well understood and whose pathways for the metabolism of sulfur-containing amino acids have been extensively investigated. Such thiophene degraders can be genetically analyzed, and the genes involved can be cloned in order to amplify their products. The second approach is the development of naturally occurring bacteria capable of thiophene degradation. Enrichment culture techniques, mutagenesis of current isolated strains, and mixed culture studies with crushed coal comprise an alternative approach in our study. The degradation rates of our model-thiophene compounds and the preliminary testing of our isolates with coal will index the efficiency of our strains in coal desulfurization. Ultimately, the genes responsible for thiophene degradation by our isolated strains will be transferred to our E. coli strain, creating a single organism capable of degrading a broad spectrum of thiophene compounds. 14 refs., 5 tabs.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 21883, 21886, 21920, 22243, 22456, 23085, 23086, 23087, 23088, 23089, 23090, 23091, 23101

23207 (IAEA-AL—004, pp 30) **Proximate analyses in foods.** Tanner, J.T. (Food and Drug Administration, Washington, DC (USA)). Oct 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88705971/JAW. (CONF-8710451—).

From IAEA-NBS international workshop on practical analytical approaches to the assessment of human dietary intake of nutrients, toxic constituents and radionuclides; Gaithersburg, USA (2 Oct 1987).

23208 **(INIS-XN—165) Order of 3 May 1988 on treatment of frozen frogs' legs by ionizing radiation.** (International Atomic Energy Agency, Vienna (Austria)). 8 May 1988. 1p. (In French). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706192/JAW.

Published in the Journal officiel de la Republique francaise.

This order fixes the conditions for the sale of frogs' legs whose microbial decontamination was obtained through exposure to cobalt 60 or cesium 137 gamma-rays or accelerated electron beams with an energy below or equal to 10 Mev.

23209 **(INIS-XN—166) Order of 4 November 1988 on treatment by ionizing radiation of rice flour and its products obtained by turbo-separation.** (International Atomic Energy Agency, Vienna (Austria)). 13 Nov 1988. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706193/JAW.

This Order fixes the conditions for the sale of rice flour and products obtained from its turbo-separation whose microbial decontamination was obtained through exposure to cobalt 60 or cesium 137 gamma-rays or accelerated electron beams with an energy below or equal to 10 Mev. (NEA).

23210 **Modelling of atmospheric effects on the angular distribution of a backscattering peak.** Powers, B.J.; Gerstl, S.A.W. (Los Alamos National Lab., Theoretical Div., MS-P371, Los Alamos, NM (US)). pp v of IGARSS '87, volume 1, remote sensing: Understanding the earth as a system. Piscataway, NJ; IEEE Service Center (1987). (CONF-870576—).

From IGARSS '87: international geoscience and remote sensing symposium - understanding the earth as a system; Ann Arbor, MI, USA (18 May 1987).

If off-nadir satellite sensing of vegetative surfaces is considered, understanding the angular distribution of the radiance exiting the atmosphere in all upward directions is of interest. Of particular interest is the discovery of those reflectance features which are invariant to atmospheric perturbations. When mono-directional radiation is incident on a vegetative scene a characteristic angular signature called the hot-spot is produced in the solar retro-direction. The remotely sensed hot-spot is modified by atmospheric extinction of the direct and reflected solar radiation, atmospheric backscattering, and the diffuse sky irradiance incident on the surface. It is demonstrated, however, by radiative transfer calculations through model atmospheres that at least one parameter which characterizes the canopy hot-spot, namely its angular half width, is invariant to atmospheric perturbations.

23211 **An atmospheric correction algorithm for remote identification of non-Lambertian surfaces and its range of validity.** Gratzki, A.; Gerstl, S.A.W. (Los Alamos National Lab., Theoretical Div., MS-P371, Los Alamos, NM (US)). pp v of IGARSS '87, volume 1, remote sensing: Understanding the earth as a system. Piscataway, NJ; IEEE Service Center (1987). (CONF-870576—).

From IGARSS '87: international geoscience and remote sensing symposium - understanding the earth as a system; Ann Arbor, MI, USA (18 May 1987).

The usefulness of remotely sensed surface data depends on the ability to correct for atmospheric perturbations on the image.

An atmospheric correction algorithm, which removes atmospheric perturbations from off-nadir measured radiances at the top of the atmosphere in the visible and near-infrared wavelength region, has been proposed previously. The ability of the model to reproduce radiance distributions at the surface from radiances at the top of the atmosphere is tested and found to be better then 15%. The correction formalism requires as minimum information the total optical depth of the atmosphere and the surface albedo. In this study the accuracy of the model to assumptions about the aerosol phase function. The single-scattering albedo and the vertical profile of the optical depth is also tested.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 22187

23212 **(CONF-881070—3) Analyses of critical target cell responses during preclinical phases of evolving chronic radiation-induced myeloproliferative disease-exploitation of a unique canine model.** Seed, T.M.; Kaspar, L.V.; Tolle, D.V.; Fritz, T.E.; Frazier, M.E. (Argonne National Lab., IL (USA); Battelle Pacific Northwest Lab., Richland, WA (USA)). 1988. Contract W-31109-ENG-38. 17p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007503/JAW.

From Symposium on multi-level health effects research: molecules to man; Richland, WA, USA (17 Oct 1988).

This document briefly summarizes and highlights ongoing studies on the cellular and molecular processes involved in the induction and progression of myeloid leukemia in dogs chronically exposed to low daily doses of wholebody gamma irradiation. Under such conditions, select groups of dogs exhibit extremely high frequencies of myeloproliferative disease (MPD) (i.e., {congruent}50%) of which myeloid leukemia is most prominent. 2 figs.

23213 **(CONF-890470—5) Using computer-based training to facilitate radiation protection review.** Abercrombie, J.S.; Copenhaver, E.D. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008238/JAW.

From 8. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (23 Apr 1989).

In a national laboratory setting, it is necessary to provide radiation protection overview and training to diverse parts of the laboratory population. This includes employees at research reactors, accelerators, waste facilities, radiochemical isotope processing, and analytical laboratories, among others. In addition, our own radiation protection and monitoring staffs must be trained. To assist in the implementation of this full range of training, ORNL has purchased prepackaged computer-based training in health physics and technical mathematics with training modules that can be selected from many topics. By selection of specific modules, appropriate radiation protection review packages can be determined to meet many individual program needs. Because our radiation protection personnel must have some previous radiation protection experience or the equivalent of an associate's degree in radiation protection for entry level, the computer-based training will serve primarily as review of major principles. Others may need very specific prior training to make the computer-based training effective in their work situations. 4 refs.

23214 **(DOE/EH—0086) Safety appraisal of the program to control and monitor worker internal radiation exposure at the Feed Materials Production Center Fernald, Ohio (With transmittal memorandum).** (USDOE Assistant Secretary for Environment, Safety and Health, Washington, DC (USA). Office of Safety Policy and Standards). Mar 1989. 149p. NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008934/JAW.

The purpose of this Appraisal was to determine the safety adequacy of the Feed Materials Production Center (FMPC) radiological protection program as it related to the control and monitoring of worker internal exposure to radioactive materials. The appraisal was prompted by the concern of a Federal agency that the plant was unsafe for its workers based on preliminary indications that uranium was present in the urine of one of its inspectors after a short visit to the site. The concern led to the termination of further visits by the Agency's inspector. The inspector did not enter process areas of the site where internal exposures, if any, would be most likely to occur. In addition, no FMPC employees in the same area at the same time as the inspector showed any positive urine results. Findings of the appraisal team do not support the plausibility of an actual intake by the inspector during a site visit.

23215 **(DOE/ER/60662—7) Radon-222 and its short-lived decay products in attached and free-ion forms in the atmosphere.** Wilkening, M.; McNamee, E. (New Mexico Inst. of Mining and Technology, Socorro (USA). Dept. of Physics). 1987. Contract FG04-88ER60662;FG04-86ER60432. 10p. (CONF-871208—4). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009375/JAW.

From 4. international symposium on the natural radiation environment; Lisbon, Portugal (7 Dec 1987).

The short-lived radionuclides in the radon decay series account for a major part of the integral dose under normal conditions. While most of this comes from atoms attached to aerosols, a significant component is due to decay products in the form of positive ions. In this study the average indoor ^{222}Rn level of 32 Bq m/sup {minus}3/ yielded an activity of about 2 Bq m/sup {minus}3/ from the positively charged ions. Out of a total potential alpha-energy concentration of 7.1 {times} 10/sup {minus}8/ J m/sup {minus}3/, the positive decay-product ions accounted for two percent. The nuclides of the radon decay series are the chief ionizing agents in the lower atmosphere. The mean indoor ^{222}Rn level in this work produces about 20 {times} 10^6 ion pairs m/sup {minus}3/ s/sup {minus}1/. This is sufficient to yield positive and negative ion densities in the air of 130 {times} 10^6 m/sup {minus}3/ and conductivity values of about 4 {times} 10/sup {minus}14/ (ohm - m)/sup {minus}1/. The ^{222}Rn positive ions make up only about 7 ppM of the total positive ions present. Corrections among the measured quantities are given which aid in the understanding of ^{222}Rn daughters in indoor air. 12 refs., 1 fig., 1 tab.

23216 **(DOE/EV/00119—T3) Research in radiobiology: Annual report of work in progress in the internal irradiation program.** Miller, S.C.; Buster, D.S. (eds.). (Utah Univ., Salt Lake City (USA). Radiobiology Div.). 31 Dec 1987. Contract AC02-76EV00119. 175p. (COO—119-263). NTIS, PC A08/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009046/JAW.

In the early 1950's the Atomic Energy Commission established at the University of Utah a large, long-term study designed to investigate the toxicity of internally deposited radionuclides in beagles. The first animals were injected on December 1, 1952 and thus began an odyssey unusual in modern science both for its duration and continued scientific interest and relevance. The original dogs were injected with ^{239}Pu and ^{226}Ra. Later, studies were initiated with ^{241}Am, ^{249}Cf, ^{252}Cf, ^{253}Es, ^{224}Ra, ^{228}Ra, ^{90}Sr, and ^{228}Th. These studies were unique and have and will continue to contribute valuable scientific information on the behavior and effects of these substances in biological systems. We feel that the data collected from these studies will be useful for many decades to come as we ask more demanding questions relative to radionuclides and environmental, biological and health issues. While this publication will be the last of our series Research in Radiobiology, the lifespan carcinogenesis studies are continuing under a collaborative arrangement with the I.T.R.I. Beginning in 1988, the colony status tables of dogs in the Utah studies and reports of research by the Radiobiology faculty will be included in the annual I.T.R.I. report. Under our new collaborative arrangements with the I.T.R.I. for the conduct of the lifespan carcinogenesis studies, we expect a continued high level of scientific productivity from our faculty.

23217 **(GSF—21/88) 1987 statistical results of the Official Personal Dosimetry Service at GSF (Dosemeter Records Office).** Drexler, G.; Eckerl, H.; Haid, G.; Scheibe, D. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)). Aug 1988. 51p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88757360/JAW.

The report consists of a summary of relevant statistical data from the official personal dosimetry in 1987. Under survey were occupationally exposed persons in the states of Bavaria, Hesse and Schleswig-Holstein. The data are based on the survey of more than 6 700 institutions with over 84 500 persons and are derived from approx. 1 Million single measurements. The report covers informations on the institutions, on the persons as well as dosimetric values. The measuring method is described briefly with respect to dosimeters used, their range and the interpretation of values. Information on notional doses and the interpolation of values nearby the detection limits are given.

23218 **(ICEFIZ-RB—19-1987) Some aspects concerning dose and activity estimation in the case of the incidental radioactive contamination in Romania in the summer of 1986.** Ionescu-Pallas, M.; Oncescu, M. (Institutul de Fizica si Tehnologia Aparatelor cu Radiatii, Bucharest (Romania); Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania)). (Central Inst. of Physics, Bucharest (Romania)). Jun 1987. 26p. (In Romanian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706020/JAW.

Radionuclide-that is fission products- migration pathways in the human body organs are being modelled. A method for calculating body irradiation in terms of radioactive contamination is suggested. Data obtained for the 1986 accidental irradiation are compared to those derived from other sources. (authors).

23219 **(JINR—19-88-151) Genotype influence on the prophage λ induction in lysogens E. coli exposed to ionizing radiation with different LET.** Bonev, M.N.; Kozubek, S.; Krasavin, E.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1988. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706222/JAW.

Submitted to the journal Radiology.

The prophage λ induction dependence on the radiations with different LETs in lysogen cells E.coli of different repair genotypes has been invesigated. The bacterial strains W3110, P3478, GC244 and 30S0 have been exposed to γ-rays and helium ions with LET=22 keV/μm. The prophage λ induction in the strains GC244 and 30S0, defective in lexA and recA genes is either reduced (GC244) or completely absent (30S0). The induction potency in the strain P3478 with mutation in the polA increases with respect to the wild type by a factor of 12 for γ-irradiation and 5 for helium ions. 11 refs.; 3 figs.; 1 tab.

23220 **(JINR-E—19-88-197) Role of DNA repair processes in the biological efficiency of heavy ions.** Krasavin, E.A.; Amirtaev, K.G.; Kozubek, S.; Tokarova, B.; Tcherevatenko, A.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1988. 7p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706235/JAW.

Submitted to the journal Stud. Biophys. .

Survival curves of E. coli wild type, recA, and Gam/sup r/ 444 strains for different types of radiation were measured. The dependence of the radiosensitivity (D/sub 0//sup -1/) on LET (L) in the case of recA mutant is continuously decreasing. The dependence D/sub 0//sup -1/(L) in the case of wild type and superresistant mutant cells has a local maximum for L=100 keV/μm. For L > 100 keV/μm the sensitives of all three bacterial strains do not differ significantly. 10 refs.; 2 figs.; 2 tabs.

23221 **(JINR-R—19-88-203) Influence of pre-radiation cultivation conditions on induction of mutation in γ-irradiated bacteriae Escherichia coli.** Tokarova, B.; Amirtaev, K.G.; Krasavin, E.A.; Kozubek, S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1988. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706264/JAW.

Submitted to the journal Radiobiologiya.

Influence of pre-radiation cultivation conditions on survival and mutation frequency of γ-irradiated bacteriae E. coli AB 1157 and Hfr H has been studied. The radiation sensitivity of cells and mutagenesis are shown to depend on the cultivation medium. The variations are considered to be due to different expression efficiency of genes controlling the inductive SOS reaction of the cells. 13 refs.; 2 figs.; 1 tab.

23222 **(JINR-R—19-88-340) Regularities in the formation of gamma-induced mutants of Saccharomices cerevisiae.** Chepurnoj, A.I.; Mikhova-Tsenova, N.; Bruntsova, H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1988. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706265/JAW.

Submitted to the journal Genetika.

The formation of reversions of the leu2 gene in Saccharomyces cerevisiae as an example indicates that the process of mutant formation after gamma-irradiation occures during of the postirradiation replication replication phases. When DNA replication is absent the mutants are not formed. The realizing periods of premutation lesions to mutations depend in what of cell cycle phase the cells were under irradiation. 16 refs.; 8 figs.

23223 (KURRI-TR—306, pp 1-8) **Chromosomal aberration. Its classification and the mechanism of its formation.** Ishii, Yutaka. (Osaka Univ. (Japan). Faculty of Medicine). Jul 1988. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89003362/JAW. (CONF-8802121—).

From Symposium on radiation-induced chromosomal aberrations; Kyoto, Japan (19 Feb 1988).

Chromosomal aberrations are classified into two types, chromosome-type and chromatid-type. Chromosome-type aberrations include terminal deletion, dicentric, ring and interstitial deletion, and chromatid-type aberrations include achromatic lesion, chromatid deletion, isochromatid deletion and chromatid exchange. Clastogens which induce chromosomal aberration are divided into "S-dependent" agents and "S-independent". It might mean whether they can induce double strand breaks independent of the S phase or not. Double strand breaks may be the ultimate lesions to induce chromosomal aberrations. Caffeine added even in the G/sub 2/ phase appeared to modify the frequency of chromatid aberrations induced by X-rays and mitomycin C. Those might suggest that the G/sub 2/ phase involves in the chromatid aberration formation. The double strand breaks might be repaired by "G/sub 2/ repair system", the error of which might yield breakage types of chromatid aberrations and the by-pass of which might yield chromatid exchanges. Chromosome-type aberrations might be formed in the G/sub 1/ phase.

23224 (KURRI-TR—306, pp 9-16) **Chromosome aberrations in A-bomb survivors, Hiroshima and Nagasaki.** Awa, Akio; Ohtaki, Kazuo. (Radiation Effects Research Foundation, Hiroshima (Japan)). Jul 1988. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89003362/JAW. (CONF-8802121—).

From Symposium on radiation-induced chromosomal aberrations; Kyoto, Japan (19 Feb 1988).

Radiation-induced chromosome rearrangements are known to have persisted in the peripheral blood lymphocytes of atomic bomb survivors in Hiroshima and Nagasaki. A dose-response relationship for chromosome aberration frequencies has been observed in both cities. A preliminary analysis of cytogenetic data indicates that the inter-city difference observed with the T65D dose estimate becomes less pronounced with the new DS86 dosimetry system. The regression coefficient of the dose-response curves is nevertheless higher in Hiroshima than in Nagasaki. The majority of chromo-

some aberrations detectable to date are of the stable type, such as translocations and inversions, and they have formed the dose-response relationship.

23225 (KURRI-TR—306, pp 17-23) **Human hereditary diseases associated with elevated frequency of chromosome aberrations.** Ejima, Yosuke. (Kyoto Univ. (Japan). Radiation Biology Center). Jul 1988. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89003362/JAW. (CONF-8802121—).

From Symposium on radiation-induced chromosomal aberrations; Kyoto, Japan (19 Feb 1988).

Human recessive diseases collectively known as chromosome breakage syndromes include Fanconi's anemia, Bloom's syndrome and ataxia telangiectasia. Cells from these patients show chromosome instabilities both spontaneously and following treatments with radiations or certain chemicals, where defects in DNA metabolisms are supposed to be involved. Cells from patients with ataxia telangiectasia are hypersensitive to ionizing radiations, though DNA replication is less affected than in normal cells. Chromatid-type as well as chromosom-type aberrations are induced in cells irradiated in G/sub 0/ or G/sub 1/ phases. These unusual responses to radiations may provide clues for understanding the link between DNA replicative response and cellular radiosensitivity. Alterations in cellular radiosensitivity or spontaneous chromosome instabilities are observed in some patients with congenital chromosome anomalies or dominant diseases, where underlying defects may be different from those in recessive diseases.

23226 **(NCRP—96) Comparative carcinogenicity of ionizing radiation and chemicals.** (National Council on Radiation Protection and Measurements, Bethesda, MD (USA)). 1 Mar 1989. 186p. National Council on Radiation Protection and Measurements, 7910 Woodmont Avenue, Suite 800, Bethesda, MD 20814-3095.

This report was prepared for the purpose of evaluating the extent to which the principles and methods that have been developed for use in assessing the carcinogenic risks of ionizing radiation are applicable in assessing the carcinogenic risks of chemicals. In addressing this question, a review of the status of knowledge concerning the carcinogenic effects of radiation and chemicals, with particular reference to their comparative mechanisms of action and dose-response relationships, was performed. Also reviewed were mathematical models for predicting the carcinogenic risks of radiation and chemicals under exposure conditions where human data are fragmentary or lacking. No attempt is made herein at an exhaustive presentation of the vast amount of pertinent information that is available. Instead, this Report seeks to summarize the cogent evidence and to provide references to authoritative sources for those readers desiring further details.

23227 **(ORNL—6518) Health and Safety Research Division progress report for the period April 1, 1987--September 30, 1988.** Kaye, S.V. (Oak Ridge National Lab., TN (USA)). Mar 1989. Contract AC05-84OR21400. 208p. NTIS, PC A10/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008979/JAW.

The mission of the Health and Safety Research Division (HASRD) is to provide a sound scientific basis for the measurement and assessment of human health impacts of radiological and chemical substances. Our approach to fulfilling this mission is to conduct a broad program of experimental, theoretical, and field research based on a strong foundation of fundamental physical studies that blend into well-established programs in life sciences. Topics include biomedical screening techniques, biological and chemical sensors, risk assessment, health hazards, dosimetry, nuclear medicine, environmental pollution monitoring, electron-molecule interactions, interphase physics, surface physics, data base management, environmental mutagens, carcinogens, and tetratogens.

23228 **(RD-E—8608-255) Result of measuring inner radioactive contamination of people due to the Chernobyl accident.** Ackers, J.G.; Julius, H.W.; Verhoef, C.W.; Aten, J.B.T.; Gerritsen, A.J.M.; TNO, Radiologische Dienst - J.A. Cohen Instituut Collaboration. (TNO, Arnhem (Netherlands). Radiologische Dienst; Cohen (J.A.) Inst. voor Radiopathologie en Stralenbescherming, Leiden (Netherlands)). (Radiologische Dienst TNO, Arnhem (Netherlands)). Aug 1986. 23p. (In Dutch). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706271/JAW.

A survey of results of about 140 measurements of internal radioactive contamination of Dutch people in consequence of the Chernobylsk accident is presented. The measurements were performed with total body counters by the Dutch Institute for Radiopathology and Radiation Protection (IRS) and the Radiologic Department TNO (RD-TNO). 4 figs.; 3 tabs.

23229 **(RERF-TR—2-88) Effect on school performance of prenatal exposure to ionizing radiation in Hiroshima. A comparison of the T65DR and DS86 dosimetry systems.** Otake, Masanori; Schull, W.J.; Fujikoshi, Yasunori; Yoshimaru, Hiroshi. (Radiation Effects Research Foundation, Hiroshima (Japan)). Aug 1988. 36p. (In Japanese, English). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757277/JAW.

As a part of the continuing assessment of the effects on the developing embryonic and fetal brain of exposure to ionizing radiation, the school performances of prenatally exposed survivors of the atomic bombing of Hiroshima and a suitable comparison group have been studied. In this report, the changes in performance in seven school subjects according to dose are compared under the T65DR dosimetry heretofore used by ABCC-RERF, and the new dosimetry (DS86) installed in 1986. Those survivors with school performance records but without T65DR doses, or not exposed in utero, or without school records are excluded. Thus, the T65DR study group consists of 1,090 children, including 14 clinically diagnosed cases of mental retardation. DS86 tissue doses are not yet available on 161 individuals, mostly those with T65DR doses less than 0.10 Gy. The DS86 sample thus involves 929 children (85.2 %) of the T65DR study group and includes the same 14 severely mentally retarded persons. The findings can be summarized as follows: Damage to the 8 - 15 week fetal brain appears to be linearly related to the fetal absorbed dose, as judged by the simple regression of average school performance score on dose. This is so for both the T65DR study group and the DS86 sample with or without the 14 cases of retardation. Damage to the fetus exposed at 16 - 25 weeks after fertilization appears similar to that seen in the 8 - 15 week group. Canonical and multiple correlations also show a highly significant relationship of exposure 8 - 15 weeks and 16 - 25 weeks after fertilization to achievement in school. This trend is stronger, however, in the earliest years of schooling. In the groups exposed within 0 - 7 weeks following fertilization, or 26 or more weeks after fertilization, there is no evidence of a radiation-related effect on scholastic performance.

23230 **(RERF-TR—3-86) Adult health study report, 6. Results of six examination cycles, 1968 - 80 Hiroshima and Nagasaki.** Sawada, Hisao; Kodama, Kazunori; Shimizu, Yukiko; Kato, Hiroo. (Radiation Effects Research Foundation, Hiroshima (Japan)). Feb 1987. 165p. (In Japanese, English). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88757278/JAW.

The AHS clinical examination is conducted biennially to determine disease (not limited to disease) prevalence rates. No inquiry is made about deaths occurring between the cycle examinations. Since there has been a remarkable difference in cancer mortality by radiation dose it must be stated that the effects of atomic bomb radiation cannot be adequately assessed through a comparison of cancer prevalence rates alone. Nonetheless, in this study, an association between the prevalence rates of various cancers and radiation has been demonstrated, particularly for cancers with a relatively low lethality rate. In this group are cancers of the thyroid and breast where the association is strong, particularly in the younger age-groups. An association continued to be observed for

neoplasms of the lymphatic and hematopoietic tissues, and for all cancers excluding the foregoing, for which a demonstrable association to A-bomb exposure was made at an early stage. These are important findings. Further, analysis of benign tumors suggested an increase in prevalence associated with an increase in radiation dose, a finding which was not observed in the studies of autopsied cases. This finding raises a whole series of questions relating to radiation carcinogenesis. As for other diseases, strong association of increased prevalence with increased radiation dose was observed for various thyroid diseases, anemia, cataract, and calcification of the aorta. As for physical measurements and laboratory tests, relationships to radiation dose were observed concerning hemoglobin, hematocrit, erythrocyte sedimentatioin rate, and white blood cell count (WBC), in addition to growth and development retardation in the younger survivors as described in a previous report. In general, for many diseases and measurements, the association is stronger for those exposed at younger ages. Furthermore, some effects on the aging process are also suggested by the analysis.

23231 **(RERF-TR—8-86) Malignant and benign ovarian neoplasms among atomic bomb survivors, Hiroshima and Nagasaki, 1950 - 80.** Tokuoka, Shoji; Kawai, Kioko; Shimizu, Yukiko; Inai, Kouki; Ohe, Kazuhiko; Fujikura, Toshio; Kato, Hiroo. (Radiation Effects Research Foundation, Hiroshima (Japan)). Sep 1988. 23p. (In Japanese, English). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757279/JAW.

For 1950 - 80, 194 ovarian cancer cases were ascertained among the 70,030 females of the RERF Life Span Study (LSS-E85) sample, and 106 autopsied cases with benign ovarian neoplasms were ascertained among all 3,046 autopsies performed in the same sample. On the basis of microscopic review, 66 % of the cancer and 84 % of the benign tumor cases were classified by histological type. The age-adjusted ovarian cancer incidence rates showed a statistically significant increase with increased exposure dose, both in the entire exposed group ($P < 0.01$) and the microscopically reviewed subset ($P < 0.01$). This dose response was only significant ($P < 0.01$) in the latter half of the study period, 1965 - 80. The radiation effect was higher in the younger age-group at the time of the bomb (ATB) for the specific attained age or adjusted for attained age. The proportion of autopsied cases with benign ovarian tumor increased with increasing exposure dose, in both the entire series of cases ($P < 0.05$) and the microscopically reviewed subset. Statistical significance, however, was not achieved in the latter group ($P > 0.10$). The distribution of histological types of both cancer and benign tumor of the ovary did not vary significantly with radiation dose. The data are consistent with the hypothesis that radiation injury of ovaries with secondary excess of gonadotrophic hormones are important causative factors in the development of ovarian neoplasms.

23232 **(RERF-TR—11-87) In vitro radiosensitivity of human fresh T-lymphocytes by colony formation assay using PHA and recombinant Interleukin-2.** Tatsugawa, Kaori; Nakamura, Nori; Hakoda, Masayuki; Akiyama, Mitoshi. (Radiation Effects Research Foundation, Hiroshima (Japan)). May 1988. 7p. (In Japanese, English). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757280/JAW.

In vitro culture conditions for colony formation of human fresh peripheral T-cells using phytohemagglutinin (PHA) and recombinant Interleukin-2 are defined. Peripheral lymphocytes, from six individuals, were exposed to X or gamma rays in vitro, and dose-survival curves were obtained. The results showed typical sigmoid curves similar to those observed when other mammalian cells are exposed to radiation. The D/sub 10/ (dose required to kill 90 % of the cells) was found to be 3.0 to 3.5 Gy.

23233 **(RERF-TR—14-87) Tracheobronchial calcification in adult health study subjects.** Fukuya, Tatsuro; Mihara, Futoshi; Kudo, Sho; Russell, W.J.; Delongchamp, R.R.; Vaeth, M.; Hosoda, Yutaka. (Radiation Effects Research Foundation, Hiroshima (Japan)). Apr 1988. 10p. (In Japanese, English). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757281/JAW.

Tracheobronchial calcification is reportedly more frequent in women than in men. Ten cases of extensive tracehobronchial calcification were identified on chest radiographs of 1,152 consecutively examined Adult Health Study subjects, for a prevalence of 0.87 %. An additional 51 subjects having this coded diagnosis were identified among 11,758 members of this fixed population sample. Sixty of the 61 subjects were women. The manifestations and extent of this type of calcification and its correlations with clinical and histopathologic features, which have not been previously reported, are described here.

23234 **(RERF-TR—15-87) Comparison of the 12-year mortality and predictive factors of coronary heart disease among Japanese men in Japan and Hawaii.** Yano, Katsuhiko; Maclean, C.J.; Reed, D.M.; Shimizu, Yukiko; Sasaki, Hideo; Kodama, Kazunori; Kato, Hiroo; Kagan, A. (Radiation Effects Research Foundation, Hiroshima (Japan)). Aug 1988. 19p. (In Japanese, English). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757282/JAW.

The mortality and predictive factors of coronary heart disease (CHD) among men of Japanese ancestry in Japan and Hawaii were compared on the basis of 12 - year follow-up data using comparable methods of case ascertainment and risk factor measurements. Among 1,687 men (Japan) and 7,536 men (Hawaii) who were free of CHD and aged 45 - 69 at baseline examination, 20 (Japan) and 123 (Hawaii) cases of fatal CHD were identified. The age-adjusted mortality rate was 40 % higher in Hawaii than in Japan. The difference was not statistically significant, but consistent with earlier studies. More than half of this difference in mortality rate was attributed to different levels of known risk factors in the two cohorts. In multivariate analysis using the combined population, age, blood pressure, serum cholesterol, serum glucose, cigarette smoking, and alcohol intake (inversely) remained as significant predictors of CHD mortality. Although the associations of risk factors with CHD tended to be stronger in Hawaii than in Japan, there was no statistically significant difference in regression coefficient for any of the risk factors studied. These findings cannot be claimed definitive because of the small number of cases, especially in Japan.

23235 **(RERF-TR—16-87) Severe mental retardation among the prenatally exposed survivors of the atomic bombing of Hiroshima and Nagasaki. A comparison of the T65DR and DS86 dosimetry systems.** Otake, Masanori; Yoshimaru, Hiroshi; Schull, W.J. (Radiation Effects Research Foundation, Hiroshima (Japan)). May 1988. 40p. (In Japanese, English). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757283/JAW.

In March 1986, as a result of a comprehensive reevaluatioin of the exposures of the survivors of the A-bombing of Hiroshima and Nagasaki, a new method for the estimation of individual doses was introduced, termed the Dosimetry System 1986 (DS86). In the new system they are computed individually without the use generally of explicit, average correction factors and thus allow better for the scattering of radiant energy that occurs within tissues. The comparisons described here rest on the computed dose to the mother's uterus. The DS86 sample itself consists of 1,544 individuals (96.6 %) of the 1,598 belonging to the clinical sample on whom T65DR doses are available. A variety of models with and without a threshold have been fitted to the individual as well as grouped dose data to ascertain the most suitable dose-response relationship. Briefly the findings of this comparison are as follows: The risk of severe mental retardation due to radiation exposure changes little from one dosimetric system to the other. The highest risk of radiation damage to the embryonic and fetal brain occurs 8 - 15 weeks after fertilization under both the T65DR and DS86 systems. Somewhat more evidence exists under the DS86 system of a threshold to the dose-response relationship in the 8 - 15 week interval than existed with the T65DR doses. However, the location and reality of the threshold are difficult to assess. Damage to the fetus 16 - 25 weeks after fertilization seems linear-quadratically or quadratically related to dose, especially in the DS86 sample, and suggests a threshold in the neighborhood of 0.70 Gy (DS86 dose), under a linear model using the individual dose data, with a lower 95 % confidence bound of 0.21 Gy. Grouped dose data give the same lower bound, but an estimate of the threshold of 0.64 Gy.

23236 **(RERF-TR—18-87) Increased somatic cell mutant frequency in atomic bomb survivors.** Hakoda, Masayuki; Akiyama, Mitoshi; Kyoizumi, Seishi; Awa, A.A.; Yamakido, Michio; Otake, Masanori. (Radiation Effects Research Foundation, Hiroshima (Japan)). May 1988. 14p. (In Japanese, English). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757284/JAW.

Frequencies of mutant T-cells in peripheral blood, which are deficient in the activity of hypoxanthine guanine phosphoribosyltransferase (HPRT) were determined for atomic bomb survivors by direct clonal assay using a previously reported method. Results from 30 exposed survivors (exposed to more than 1 rad) and 17 age- and sex-matched controls (exposed to less than 1 rad) were analyzed. The mean mutant frequency (Mf) in the exposed (5.2 x 10/sup -6/; range 0.8 - 14.4 x 10/sup -6/) was significantly higher than in controls (3.4 x 10/sup -6/; range 1.3 - 9.3 x 10/sup -6/), a fact not attributable to lower nonmutant cell cloning efficiencies in the exposed group since cell cloning efficiencies were virtually identical in both groups. An initial analysis of the data did not reveal a significant correlation between individual Mfs and individual radiation dose estimates when the latter were defined by the original, tentative estimates (T65D), even though there was a significant positive correlation of Mfs with individual frequency of lymphocytes bearing chromosome aberration. However, reanalysis using the newer revised individual dose estimates (DS86) for 27 exposed survivors and 17 controls did reveal a significant but shallow positive correlation between T-cell Mf values and individual exposure doses. These results indicate that HPRT mutation in vivo in human T-cells could be detected in these survivors 40 years after the presumed mutational event.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 23064, 23226, 23227

23237 **(CONF-881274—1) Biological markers in animal sentinels: Laboratory studies improve interpretation of field data.** McCarthy, J.F.; Jimenez, B.D.; Shugart, L.R.; Sloop, F.V.; Oikari, A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 30p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007829/JAW.

From Symposium on in situ evaluation of biological hazards of environmental pollutants; Chapel Hill, NC, USA (5 Dec 1988).

This paper described some of the results of our studies of biomarker responses of fish. We report results of field surveys of animals from contaminated and unpolluted reference streams, as well as laboratory studies of biomarker responses. The goal of this presentation is to emphasize two points that are critical to the successful application and interpretation of biomarker responses in environmental species. It is necessary to measure a suite of biomarkers. No single biomarker can provide all the information necessary to evaluate exposure or it significance. Furthermore, the responses of one biomarker provide information that improves interpretation of other biomarkers. The responses of biomarkers reflect a complex biological response to the entire exposure scenario. Cumulative stress from the environment, including temperature, crowding, food availability, and parasites, as well as low-level insults from nontoxic concentrations of complex mixtures of chemicals, can significantly affect the response of an organism to toxic contaminants. Damage from environmental pollutants may not be a simple dose-dependent function of how much of what chemical enters an animal; the same exposure may cause more toxic damage to a stressed animal. However, the power of biomarkers in evaluation of in situ hazards is that they provide biologically significant insights into cumulative effects of integrated exposure situations. 18 refs., 7 figs.

23238 **(IDSP—1987) Report to the Worker's Compensation Board on occupational exposure to PCBs and various cancers.** (Industrial Disease Standards Panel, Toronto, Ontario (Canada)). 1987. 129p. (MICROLOG—88-04657). Industrial Disease Standards Panel, 10 King St., East, 7th Floor, Toronto, ON, Canada M5C 1C3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report presents information relevant to the possible incidence of various cancers among Ontario workers exposed to polychlorinated biphenyls (PCB). Experimental animal studies, human morbidity studies, and human mortality studies are reviewed, and PCB usage in Ontario is surveyed. The majority of PCB use in the province is for electrical transformers (85%), and worker exposure can occur in the manufacture, maintenance, and repair of these devices and other electrical components such as capacitors. Epidemiologial evidence indicates excess cancers of the liver, biliary tract and gall bladder appear in workers exposed to PCB. There is also evidence of increasing risk with increasing total employment in manufacturing plants using PCB. Strong support from animal studies exists to show the induction of hepatocellular and extra-hepatic biliary tract carcinomas from PCB ingestion. However, there is support only for the promotional action of PCB in the production of liver cancers in the human epidemiology. Finally, there is support for the linkage of PCB exposure with liver, biliary tract and gall bladder cancers from the similarity of results from human exposure to chemical compounds with molecular structures similar to PCB. 99 refs., 2 figs., 33 tabs.

23239 **(LBL—26566) The use of medium scale experiments to determine smoke characteristics.** Fleischmann, C.M.; Dod, R.L.; Brown, N.J.; Novakov, B.T.; Mowrer, F.W.; Williamson, R.B. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 34p. (CONF-881272—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008333/JAW.

From International symposium on characterization and toxicity of smoke; Phoenix, AZ, USA (5 Dec 1988).

A series of medium-scale smoke experiments were conducted at the University of California, Berkeley. Representative fuels, such as wood, asphalt roofing shingles, and liquid hydrocarbons, were burned as medium scale fuel packages in the open, with no restriction on the ventilation. For some of the fuels, the experiments were also conducted in a burn room under limited ventilation conditions. The effects of different combustion conditions resulting from differences in fuel composition, geometry, and ventilation were determined. Smoke emission factors measured for burning wood under well ventilated conditions were in the range of 0.1 to 0.3 percent, but under limited ventilation conditions they increased an order of magnitude to the 2 to 3 percent range. Under well ventilated conditions, the smoke emission factors measured for asphalt were in the 12 percent range and those for No. 2 fuel oil were in the 11 percent range. Burning in the compartment also affected the emission factors and smoke characteristics of fuel oil. 14 refs., 14 figs., 3 tabs.

23240 **(NP—9770295) Carcinogenicity study in rodents - combined effects of coal oven exhaust (enriched with PAH) with two metal compounds or glass-microfibers. Final report.** Heinrich, U.; Pott, F.; Peters, L.; Rittinghausen, S.; Fuhst, R.; Levsen, K. (Fraunhofer-Institut fuer Toxikologie und Aerosolforschung (ITA), Hannover (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1987. 54p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE89770295/JAW.

In a lifetime-inhalation experiment with male and female Syrian golden hamsters the possible carcinogenic potency of a coal oven exhaust, enriched with PAH from pitch pyrolysis, was investigated. Part of the animals had additionally been i.tr. treated with calciumarsenate, cadmiumoxide or glass-microfibres to investigate also cocarcinogenic or syncarcinogenic effects. The animals were exposed 15 h/day, 5 days/week for about 22 monts and were kept in clean air for additional 8.5 months. The average particle concentration was 7 mg/m/sup 3/, and the BaP content 14 μg/mg particles or 100 μg BaP/m/sup 3/ resp. The MMAD of the particles was about 0.8 μm and the average concentration of SO/sub 2/ and NO/sub 2/ was 8.0 and 0.3 ppm. Severe exposure- or treatment related effects on mortality or bodyweight gain could not be detected. There were no remarkable non-neoplastic histopathological findings in the upper respiratory tract. In the lungs of the exposed animals frequently hyperplasia, squamous metaplasia and histiocytosis were found, mostly with those animals treated intratracheally with CdO. After exhaust exposure alone or in combination with As, Cd, or glassfibres only the combination exhaust plus As resulted in

a significant increase of the tumor incidence in the upper respiratory tract but not in the lungs. Contrary to these findings rats and mice showed an exhaust related increase in the lung tumor rate after inhalation of this PAH-rich exhaust. Therefore, the Syrian golden hamster can no longer be recommended to be included in such investigations because this species showed no lung tumors after inhalation of an exhaust gas which is known to increase the lung tumor risk of exposed humans. (orig./MG) With 39 refs., 9 tabs., 23 figs.

23241 **(UCRL—98748) Cancer-risk prediction for carbon tetrachloride using pharmacokinetic and cell-kinetic multistage models.** Bogen, K.T. (Lawrence Livermore National Lab., CA (USA)). Feb 1989. Contract W-7405-ENG-48. 30p. (CONF-8810249—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008609/JAW.

From Annual meeting of the Society for Risk Analysis; Washington, DC, USA (31 Oct 1988).

Multistage cancer risk models that account for clonal growth of intermediate, premalignant cell populations have been successfully used to describe age-specific incidence trends for human and experimentally induced animal tumors. Currently there is keen and growing interest in applying "cell-kinetic multistage" (CKM) models, which distinguish mutations and cell population kinetics as separate processes influencing the rate of tumor formation, to the problem of predicting human cancer risk that may be posed by environmental agents. This paper illustrates the application of such models to cancer-risk prediction for carbon tetrachloride (CCl_4), using data from rodent cancer bioassays and information on CCl_4 pharmacokinetics in rodents and humans. The presumption, made in most CKM models considered to date, that preneoplastic cell growth is exponential over time is critically evaluated along with the impact on predicted CCl_4-induced cancer risk of using a more biologically realistic cell-growth model. Equations describing modeled exponential and geometric CKM-based risk from multiple exposure scenarios are developed and applied to the problem of risk population for CCl_4. It is shown that if CCl_4 is assumed to be a "pure" promoter of carcinogenesis (i.e., to have no cancer-initiating capacity), the CKM approach predicts a low-dose carcinogenic potency for CCl_4 that is up to four orders of magnitude less than that predicted using a widely used standard approach that does not take into account the impact of induced cell proliferation. 46 refs., 6 figs.

23242 **REV1 gene of Saccharomyces cerevisiae: isolation, sequence, and functional analysis.** Larimer, F.W.; Perry, J.R.; Hardigree, A.A. (Oak Ridge National Lab., TN (USA)). *Journal of Bacteriology;* **171**: No. 1, 230-237(Jan 1989).

The REV1 gene of Saccharomyces cerevisiae is required for normal induction of mutations by physical and chemical agents. We have determined the sequence of a 3,485-base-pair segment of DNA that complements the rev1-1 mutant. Gene disruption was used to confirm that this DNA contained the REV1 gene. The sequenced segment contains a single long open reading frame, which can encode a polypeptide of 985 amino acid residues. The REV1 transcript is 3.1 kilobase pairs in length. Frameshift mutations introduced into the open reading frame yielded a Rev-phenotype. A base substitution, encoding Gly-193 to Arg-193, was found in this open reading frame in rev1-1. Deletion mutants, lacking segments of the 5′ region of REV1, had intermediate mutability relative to REV1 and rev1-1; a complete deletion exhibited lower mutability than rev1-1. REV1 is not an essential gene. An in-frame fusion of the 5′ end of the REV1 open reading frame to the lacZ gene produced beta-galactosidase activity constitutively. The predicted REV1 protein is hydrophilic, with a predicted pI of 9.82. No homologies to RAD1, RAD2, RAD3, RAD7, or RAD10 proteins were noted. A 152-residue internal segment displayed 25% identity with UMUC protein.

57 HEALTH AND SAFETY

23243 (INIS-BR—1440, pp 66) **Cooperation of the physics department related to /sup 137/Cs accident in Goiania, Brazil.** 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 21653, 23184, 23250

23244 **(BULL—90) Geology of the Sandymush and Canton Quadrangles, North Carolina.** Merschat, C.E.; Wiener, L.S. (North Carolina Dept. of Natural Resources and Community Development, Raleigh (USA). Div. of Land Resources). 1988. 103p. OSTI - Geological Survey Section, P.O. Box 27687, Raleigh, NC 27611. Order Number TI89008889/JAW.

This report presents the results of a detailed study of the bedrock geology of the Sandymush and Canton 7 1/2-minute Quadrangles, North Carolina. The mapping project was prompted by the US Department of Energy's announcement in early 1986 that a 105-square-mile area centered on the two quadrangles was one of a dozen sites in the eastern United States proposed as potentially acceptable for deep burial of high-level radioactive waste (US Department of Energy,1986). However, for this specific area no comprehensive geologic report had ever been prepared and the few existing geologic maps were only of reconnaissance nature. The present field-based investigation has resulted in the first detailed geologic maps and rock descriptions for the Sandymush-Canton area. The basic, factual data accumulated during the study reveal that local geologic conditions do not meet the Department of Energy's stated criteria for acceptibility as a high-level radioactive-waste repository. (See the supplement to this report [Merschat and Wiener, 1988] for a discussion of the area's non-suitability as a repository.) 75 refs., 19 figs., 11 tabs.

23245 **(PPA-T—65) Tracer application in hydrology and the environment, Malaysia.** Daud Mohamad; Roslan Mohamad Ali; Wan Zakaria Wan Mohamad Tahir; Zainudin Othman; Mohamad Shahid Ayub. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). Apr 1987. 17p. (CONF-870678—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88706269/JAW.

From International groundwater conference: groundwater and the environment; Kuala Lumpur, Malaysia (22 Jun 1987).

A number of important applications of isotopes in hydrology and the environment undertaken in Malaysia are presented, i.e. environmental isotope (isotope hydrology study of Kelantan Basin); artificial isotope studies (detection of leakage in Pedu Dam; flow-rate measurement at selected streams in Ulu Langat area; residence times and dispersion behavior of oxydation pond, Klang Hospital).

5802 Geophysics

REFER ALSO TO CITATION(S) 21653, 21654, 21694, 22109, 22110, 22111, 22853

23246 **(EPRI-NP—6154-Vol.1) EPRI/NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan: Proceedings: Volume 1.** (Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1989. 539p. (CONF-871263—Vol.1). Research Reports Center, Box 50490, Palo Alto, CA 94303.

From EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan; Palo Alto, CA, USA (9 Dec 1987).

A two-and-a-half-day workshop on evaluation of seismic soil-structure interaction (SSI) analysis techniques was held in Palo Alto on December 9--11, 1987. The workshop was co-sponsored by the Electric Power Research Institute (EPRI), the United States Nuclear Regulatory Commission (NRC), and the Taiwan Power Company (TPC) as part of the joint research program on SSI method evaluation. The primary objective of the workshop was to provide a forum for the presentation and discussion of the blind

prediction analyses and results comparisons against the forced vibration test measurements and recorded earthquake response data from the EPRI/TPC large-scale seismic experiment in Lotung, Taiwan, Republic of China. These proceedings contain the test of the presentation materials as well as the summaries of panel session discussions.

23247 **(EPRI-NP—6154-Vol.2) Proceedings: EPRI/ NRC/TPC workshop on seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan: Volume 2.** (Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1989. 451p. (CONF-871263—Vol.2). Research Reports Center, Box 50490, Palo Alto, CA 94303.

From EPRI/NRC/TPC workshop on validation of seismic soil-structure interaction analysis techniques using data from Lotung, Taiwan; Palo Alto, CA, USA (9 Dec 1987).

A two-and-a-half-day workshop on evaluation of seismic soil-structure interaction (SSI) analysis techniques was held in Palo Alto on December 9--11, 1987. The workshop was co-sponsored by the Electric Power Research Institute (EPRI), the United States Nuclear Regulatory Commission (NRC), and the Taiwan Power Company (TPC) as part of the joint research program on SSI method evaluation. The primary objective of the workshop was to provide a forum for the presentation and discussion of the blind prediction analyses and results comparisons against the forced vibration test measurements and recorded earthquake response data from the EPRI/TPC large-scale seismic experiment in Lotung, Taiwan, Republic of China. These proceedings contain the text of the presentation materials as well as the summaries of panel session discussions.

23248 **(ICEFIZ-EP—34-1987) On the magnitude and recurence of Vrancea earthquakes.** Oncescu, M.C. (Centrul de Fizica Pamintului si Seismologie, ICEFIZ, Bucuresti, Romania). (Central Inst. of Physics, Bucharest (Romania)). Jul 1987. 20p. (In Romanian). NTIS (US Sales Only), PC A03/ MF A01 - OSTI; INIS. Order Number DE88706001/JAW.

The moment-magnitude scale Msub(W) is proposed for the quantification of Vrancea earthquakes. The asperity model is found adequate to explain the observed quasi-cycles and super-cycles in the occurrence of large events. (auhtor).

23249 **(ICEFIZ-EP—35-1987) Research for the physics and structure of earth's crust in Romania.** Ghitulescu, T.P.; Popescu, M.N. (Centrul de Fizica Pamintului si Seismologie,ICEFIZ, Bucuresti, Romania). (Central Inst. of Physics, Bucharest (Romania)). Oct 1987. 37p. (In Romanian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706002/JAW.

Systematic research for the deciphering of the physic and structure of Earth's crust in our country by geophysical methods were performed in the frame of Romanian Geological Institute since 1925. We put into evidence the principle achievements obtained by the geological and geophysical research for the mineral resources existing in the Romanian earth's crust. (authors).

23250 **(LBL—24200) Earth Sciences Division annual report, 1987.** (Lawrence Berkeley Lab., CA (USA)). Sep 1988. Contract AC03-76SF00098. 249p. NTIS, PC A11/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008836/ JAW.

This report summarizes the activities for 1987. Much of the Division's research deals with the physical and chemical properties and processes in the Earth's crust, from the partially saturated, low-temperature near-surface environment to the high-temperature environments characteristic of regions where magmatic-hydrothermal processes are active. Strengths in laboratory and field instrumentation, numerical modeling, and in situ measurement allow study of the transport of mass and heat through geologic media{emdash}studies that now include the appropriate chemical reactions and the hydraulic-mechanical complexities of fractured rock systems. Related and parallel laboratory and field investigations address the effects of temperature, pressure, stresses, pore fluids, and fractures on the elastic and electrical properties of rock masses. These studies are concerned with rock behavior in the brittle and ductile crustal regimes, and they drive the development of improved geomechanical and geophysical tools and techniques for mapping and characterizing heterogeneity in the subsurface. The Division has increased its emphasis on the application of fluid transport modeling and subsurface imaging methods to problems related to discovery and recovery of petroleum. Each of the 166 individual reports is presented in a publication format and contains significant new information.

23251 **(SAND—89-0492C) Deep borehole measurements for characterizing the magma/hydrothermal system at Long Valley Caldera, CA.** Carrigan, C.R. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 13p. (CONF-890352—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009324/ JAW.

From US Department of Energy research and development for the geothermal marketplace: 7th geothermal program review; San Francisco, CA, USA (21 Mar 1989).

The Magma Energy Program of the Geothermal Technology Division is scheduled to begin drilling a deep (6 km) exploration well in long Valley Caldera, California in 1989. The drilling site is near the center of the caldera which is associated with numerous shallow (5-7 km) geophysical anomalies. This deep well will present an unparalleled opportunity to test and validate geophysical techniques for locating magma as well as a test of the theory that magma is still present at drillable depths within the central portion of the caldera. If, indeed, drilling indicates magma, the geothermal community will then be afforded the unique possibility of examining the coupling between magmatic and hydrothermal regimes in a major volcanic system. Goals of planned seismic experiments that involve the well include the investigation of local crystal structure down to depths of 10 km as well as the determination of mechanisms for local seismicity and deformation. Borehole electrical and electromagnetic surveys will increase the volume and depth of rock investigated by the well through consideration of the conductive structure of the hydrothermal and underlying regimes. 9 refs., 5 figs.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 21656, 21802, 21957, 22853, 23250, 23254

5804 Geochemistry

REFER ALSO TO CITATION(S) 21653, 21656, 21691, 22260, 22261, 23250

23252 **(DOE/ER/13982—1) Chemical transport through continental crust: [Annual] progress report, 1988.** (South Dakota School of Mines and Technology, Rapid City (USA)). 20 Mar 1989. Contract FG02-88ER13982. 14p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008763/JAW.

The main objective of these studies is to understand the extent and mechanisms of chemical migration over a range of temperatures and in diverse geologic media. During 1988--1989 we continued to attack these problems through studies in the granite-pegmatite systems of the Black Hills, South Dakota. Mineral chemistry, major element chemistry and trace element modeling of the Harney Peak Granite (Black Hills, South Dakota) suggest that 75% to 80% fractional crystallization was the dominant mechanism in producing evolved tourmaline-bearing granite (high B, Li, Rb, Cs, Be, Nb) from a biotite-muscovite granite. To evaluate the petrogenetic-evolutionary relations between the granite and the surrounding rare-element pegmatite field, over 500 K-feldspars (Kf) were analyzed from 60 unzoned to complexly zoned pegmatites. Pegmatites with Kf relatively high in Ba (>140 ppM) and relatively low in Rb (<1000 ppM) and Cs (<30 ppM) are distributed in regions of high pegmatite density (>200 pegmatites/sq. mile), whereas highly evolved pegmatites with Kf enriched in Rb (>4000 ppM) and Cs (>500 ppM) are distributed in regions of low pegmatite density (<100 pegmatites/sq. mile). The extent of pegmatite evolution as reflected in the Kf documents the relation between the degree of fractionation and internal zoning characteristics. Modeling of these

data is a major task for the next grant year to provide new insights into chemical and thermal transport in the midcrust.

23253 **Iridium abundance patterns across extinction boundaries.** Orth, C.J.; Gilmore, J.S.; Oliver, P.Q.; Quintana, L.R. (Los Alamos National Laboratory, NM (USA)). *Geological Society of America, Abstracts with Programs;* **17**: 683(1985). (CONF-8510489—).

From 98. annual meeting of the Geological Society of America; Orlando, FL, USA (28 Oct 1985).

The authors are measuring elemental abundances, with emphasis on high sensitivity Ir assay, across biological crisis zones in the fossil record. Samples are measured in an automated neutron activation analysis system, with radiochemical separations for the heavy Pt-group elements and Au. They are collaborating with paleontologic and stratigraphic experts to home-in on the boundaries, and to date they have performed at least one set of measurements across the following transition and extinction boundaries: Precambrian/Cambrian(Pc/C); 2 U. Cambrian biomere boundaries; the basal Ordovician; Ordovician;/Silurian; U. Devonian Frasnian/Famennian (F/F); Devonian/Miss.; Miss./Penn.; Permian/Triassic (P/Tr); Triassic/Jurassic; L. Jurassic Toarcian; Cretaceous/Tertiary (K/T); and the U. Eocene. The authors work on K/T sequences that were deposited under freshwater conditions in the western interior of North America supports the Alvarez asteroid impact hypothesis. The Earth has been struck many times in the Phanerozoic by large impactors that probably have done tremendous damage to the local environment. However, to day scientists have not found any firm chemical evidence for the association of impacts with global extinctions older than the massive terminal Cretaceous event, which might have been unique in the Phanerozoic. Although they have measured a moderate Ir and Pt anomaly in the F/F boundary zone in NW Australia, their evidence indicates that these and several other elements were enriched from seawater by bacteria. Although the authors data, except for the U. Eocene, do not support the periodic comet swarm-global extinction arguments, much more work is needed to resolve this issue.

23254 **Alteration of shale of the David Formation overlying a Pb-Zn deposit of the Viburnum trend, S.E. Missouri.** Panno, S.V.; Sayre, E.V.; Harbottle, G. (Brookhaven National Laboratory, Upton, NY (USA)). *Geological Society of America, Abstracts with Programs;* **17**: 684(1985). (CONF-8510489—).

From 98. annual meeting of the Geological Society of America; Orlando, FL, USA (28 Oct 1985).

Ninety-five drill core samples of shale from the Davis Formation were collected from above and laterally away from the Pb-Zn deposit of the Buick mine, and examined for hydrothermal alteration. Thirty-seven samples were collected from the core of a single borehole that penetrated the entire thickness of the formation immediately above the deposit; fifty-four samples were collected at the base of the formation from boreholes that laterally traverse the ore deposit and extend up to four miles from the deposit. Each core sample was analyzed by neutron activation for twenty-six elements. Immediately above the deposit there is an apparent enrichment of K and As and an apparent depletion of Na, Mn, Fe, and Zn. K is enriched through the entire thickness of the shale above the deposit; As is enriched only at the top and base of the Davis Formation. Concentrations of Na, Mn, Fe, and Zn reveal a zone of depletion approximately 17m thick at the upper contact. The areal distribution of these elements and K and As supports the enrichment/depletion interpretation. These data suggest that ore and ore-related solutions migrated along the dolomite-shale interfaces at both the upper and lower contacts of the Davis Formation and leached Na, Mn, Fe, and Zn from the shale.

5805 Oceanography

23255 **(EC—1987) Effects of a one metre rise in mean sea-level at Saint John, New Brunswick and the lower reaches of the Saint John River. Executive Summary.** (Environment Canada, Ottawa, ON (Canada)). 1987. 30p. (In English and French). (MICROLOG—88-03086). Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

As part of a series of studies investigating the potential impacts on various sectors of the Canadian economy of climate warming due to the greenhouse effect, a study of the implications of a sealevel rise at St John, New Brunswick was undertaken. This report presents a summary of that study, whose objective was to identify and map the 1:20 year and 1:100 year storm surge and flood levels associated with higher mean sea levels, and to identify the natural and human features and activities that may be at risk. Results show that in St John, two residential areas are at risk, road and rail transportation would be affected heavily, industrial facilities located near the harbor could be affected significantly, wharves and waste treatment lagoons would be inundated, a power plant in East St. John would require floodproofing, and a causeway would have to be rebuilt. The richest farmland in the area is subjected to flooding even at present, and the impacts can only be expected to increase as the frequency and duration of flooding increases. Municipal planning in the region will have to be reviewed to ensure that the increased potential for flooding or seawater inundation is recognized and addressed. 6 refs., 1 fig., 1 tab.

64 PHYSICS I

23256 **(INIS-SU—73) Physical experiment engineering. Scientific-technical collection.** (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1988. 82p. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780082/JAW.

Individual papers are indexed separately.

23257 **(JINR—N-1-27-88) JINR rapid communications. Collection.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1988. 41p. (In Russian). NTIS (US Sales Only), PC A03/MF A01; INIS. Order Number DE89780078/JAW.

Individual papers are indexed.

23258 **(JINR—N-2-28-88) JINR rpaid communications. Collection.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1988. 64p. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780079/JAW.

Individual papers are indexed.

23259 **(JINR—N-3-29-88) JINR rapid communications. Collection.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1988. 63p. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780080/JAW.

Individual papers are indexed.

23260 **(JINR—N-6-26-87) JINR rapid communications. Collection.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. 36p. (In Russian). NTIS (US Sales Only), PC A03/MF A01; INIS. Order Number DE89780076/JAW.

Individual papers in this collection are separately indexed.

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 22998, 23014, 23416, 23547, 23604

23261 **(CEA-CONF—9690) Quasi-static evolution of a force-free magnetic field and conditions for the onset of a stellar flare.** Aly, J.J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). 1988. 5p. (CONF-880853—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757180/JAW.

From 3. international conference on applications of artificial intelligence in engineering; Stanford, CA, USA (8 Aug 1988).

Magnetic fields in the solar corona are braught into an endless evolution by the never-ceasing motions of the subphotospheric plasma in which the feet of their lines are anchored. It is generally thought that this evolution is essentially quasi-static, the field passing through a sequence of force-free equilibrium states. Sporadically, however, the equilibrium is broken in a region of limited extent, and during a relatively short interval of time a catastrophic highly dynamic evolution takes place, giving rise to such well-known phenomena as flares or coronal transients. Understanding the factors which determine if a magnetohydrostatic coronal equilibrium is maintained or, on the contrary, destroyed, when boundary conditions change at the photospheric level, then appears as a central theoretical problem of solar physics. In this Communication, we report some recent results which shed some new light onto this old problem.

23262 **(CEA-CONF—9692) Analytical study of the structure of two-dimensional magnetostatic equilibria in the presence of gravity.** Amari, T.; Aly, J.J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)). 1988. 5p. (CONF-880853—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757181/JAW.

From 3. international conference on applications of artificial intelligence in engineering; Stanford, CA, USA (8 Aug 1988).

In order to understand how prominences are supported in the solar corona, we have recently developed several 2D models describing x-invariant equilibrium configurations of a plasma occupying a half-space and submitted to a magnetic field. We report here some results concerning three of these models, which are based on different assumptions about the way matter is spatially distributed.

23263 **(CONF-890406—6) Production rates of cosmogenic nuclides in stony meteorites.** Divadeenam, M.; Gabriel, T.A.; Lazareth, O.W.; Spergel, M.S.; Ward, T.E. (Oak Ridge National Lab., TN (USA); Brookhaven National Lab., Upton, NY (USA)). 1989. Contract AC05-84OR21400;AC02-76CH00016. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003121/JAW.

From Fifty years with nuclear fission conference; Gaithersburg, MD, USA (25 Apr 1989).

Monte Carlo calculations of ^{26}Al and ^{53}Mn production due to spallation induced by cosmogenic protons in model meteorite composition similar to L Chondrite has yielded predictions which are consistent with the observed decay rates in L Chondrite stony meteorites. The calculated ^{26}Al production rate (54 dpm/kg) in a 1 m diameter meteorite is within 1/2 S.D. of the mean (49 +- 11 dpm/kg) taken from 100 bulk determinations in L Chondrite samples compiled in Nishiizumi (1987). Similarly calculated average value for ^{53}Mn (223 dpm/kg) is consistent with one S.D. off the mean in the widely scattered ^{53}Mn data (362 +- 113 dpm/kg) compiled by Nishiizumi (1987). 9 refs.

23264 **(ESA-SP—286) Seismology of the sun and sun-like stars.** (European Space Agency, 75 - Paris (France)). Dec 1988. 691p. (CONF-8809146—). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW.

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

These proceedings follow the structure of the symposium organised into eight sessions under the following headings: frequency stability: excitation and damping of oscillations; internal rotation; ground-based networks and techniques; solar cycle, magnetic fields and oscillations; space projects and low frequency oscillations; solar modelling techniques; observations and techniques for asteroseismology; models of stellar evolution from seismology.

23265 (ESA-SP—286, pp 55-66) **Solar internal rotation from helioseismology.** Harvey, J. (Arizona Univ., Tucson (US). Optical Sciences Center). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

Observations of solar oscillations allow one to determine the properties of internal solar rotation. This branch of helioseismology, like most others, is enjoying rapid growth. Many diverse methods are used to determine the internal solar rotation. Measurements of p-mode frequencies made by several groups are in essential agreement that rotation within the convection zone differs in depth and latitude only slightly from the observed rotation of the surface. Deeper layers seem to rotate with less latitudinal differential rotation. The rotation of the energy-generating core is not well determined by p-mode oscillations and it may be rotating somewhat faster or at about the same rate as the surface. Observations of g-modes support the notion of a rapidly rotating core. Great improvements in knowledge of solar internal rotation are certain as higher resolution is obtained in images, frequency, and spherical harmonic degree and order. Signal-to-noise ratio will also improve greatly with the availability of continuous data from networks and from spacecraft.

23266 (ESA-SP—286, pp 3-10) **Excitation and damping of solar oscillations (Invited Review).** Libbrecht, K.G. (California Inst. of Tech., Pasadena, CA (US)). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

I review the present status of our understanding of the excitation and damping of solar p-mode oscillations. While a few simple statements can be made about the expected properties of p-modes, there is currently no complete theory which explains the observed mode amplitudes and linewidths. I discuss below the growing evidence that the p-modes cannot be overstable and therefore self-excited, but are instead probably stochastically excited by turbulent convection. I discuss the present status of the latter model for exciting p-modes, and some possible future directions.

23267 (ESA-SP—286, pp 11-16) **On the K-mechanism and the multi-dimensional Eddington approximation.** Bueno, J.T. Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

To consider the possibility of a K-like overstability mechanism as the driving force of solar modes of oscillation requires a theoretical description of the interaction between the hydrodynamics of the motion and the radiative energy transport. The aim of this paper is to answer the question of whether or not the frequently-used multi-dimensional Eddington approximation is suitable for such purposes. It is found that Eddington's approximation is generally adequate for giving account of the radiative damping effects of Planck function fluctuations, while it is in gross disagreement with the exact results with respect to the radiative transfer effects of opacity fluctuations. Therefore, it is concluded that its use should be avoided when investigating K-like excitation mechanisms for nonradial stellar modes of oscillation.

23268 (ESA-SP—286, pp 17-20) **On the diagnostic of 5/ sup m/ oscillations through photospheric line profiles.** Bertello, L.; Caccin, B. (Florence Univ. (IT). Ist. di Astronomia; Rome Univ. (IT). Ist. di Fisica). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

Recent measurements show that the 5/sup m/ oscillations have different amplitudes in the opposite flanks of several photospheric lines. This effect can be suitably described by giving the (blue wing)/(red wing) ratio of the r.m.s. wavelength shift at any given level of residual intensity. We suggest that the main cause is radiative damping, which produces a depth dependent phase difference between the velocity and the thermodynamical (temperature and pressure) perturbations within the line forming region. Synthetic profiles of the Fe I λ6301.5 A line, obtained by numerical solution of the time independent radiative transfer equation in the oscillating atmosphere (quasi static radiation field approximation), show that agreement between observed and computed profiles can be achieved. The consequences of this effect (which is also dependent on the magnetic flux concentration) on the diagnostic properties of line profiles are briefly discussed.

23269 (ESA-SP—286, pp 21-26) **Nonlinear studies of solar gravity modes driven by nuclear burning of /sup 3/He in the core.** Merryfield, W.J.; Toomre, J.; Gough, D.O. (Joint Inst. for Lab. Astrophysics, Boulder, CO (US); Cambridge Univ. (GB). Inst. of Astronomy). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

The finite-amplitude behavior of gravity-mode oscillations driven within the deep interior of the sun has been studied by means of a simple idealized model. Such g modes may be self-excited by their ability to extract energy from the nuclear burning of / sup 3/He in the core. Both a nonlinear bifurcation analysis and numerical simulations of the behavior of this instability suggest that the growth of /sup 3/He-driven oscillations is likely be limited to an amplitude which is insufficient to induce convective instability in the core, a process which has been proposed as a mechanism for core mixing. The numerical results also indicate that if the oscillations are linearly unstable then the degeneracy in linear theory between standing and travelling g modes is broken by nonlinear effects. The oscillations thus develop into a left- or right-travelling wave rather than a standing wave or other superposition of horizontally propagating waves.

23270 (ESA-SP—286, pp 27-30) **Linewidth of low degree acoustic modes of the sun.** Elsworth, Y.; Isaak, G.R.; McLeod, C.P.; New, R.; Jefferies, S.M.; Palle, P.L.; Regulo, C.; Roca Cortes, T. (Birmingham Univ. (GB); Delaware Univ., Newark (US). Bartol Research Foundation). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

Estimates of the spectral linewidths of low degree (l=0 and l=1), "5 minute" p-modes obtained from Doppler shift observations in 1984, 1986 and 1987 are reported. The observed linewidths increase from 0.5 μHz at 2000 μHz to 3.8 μHz at 4300 μHz for l = 0. Comparison with other data suggest that for a given frequency the linewidth increases with increasing l value. On the assumption that the linewidth is substantially due to damping processes the line widths are consistent with e-folding times between 3.7 and 0.5 days.

23271 (ESA-SP—286, pp 31-36) **Measurements of high degree solar oscillation amplitudes.** Kaufman, J.M. (California Inst. of Tech., Pasadena, CA (US)). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

We present measurements of high degree solar oscillation velocity amplitudes that have been corrected for the effects of atmospheric seeing. Observations of high degree oscillations, which have very small spatial features, suffer from the effects of atmospheric image blurring and image motion, thereby reducing the amplitudes of their spatial frequency components. In an attempt to correct the velocity amplitudes for these effects, we have simultaneously measured the atmospheric modulation transfer function (MTF) by looking at the effects of seeing on the solar limb. We find that the peak velocity power decreases by {similar←to} 2.6 and the energy per mode decreases by a factor of {similar←to} 5 as l increases from 200 to 700. These results allow us to conclude that the modes are not in energy equipartition with convective turbulent eddies in the top of the convection zone.

23272 (ESA-SP—286, pp 37-46) **Dynamics of the overshoot layers and boundary conditions in helioseismology.** Nesis, A. (Freiburg Univ. (DE)). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

The variation of both the horizontal and the vertical small scale rms velocity with height in the photosphere shows a minimum in photospheric layers about 150-200 km above the continuum. In the context of the non-equilibrum thermodynamics we suppose that the small scale rms velocity variation reflects the variation of the entropy production in these layers. We propose that the upper boundary of theoretical helioseismology models should be placed at that height where the entropy production shows its minimum.

23273 (ESA-SP—286, pp 47-54) **On radiative and convective influences on stellar pulsational stability.** Balmforth, N.J.; Gough, D.O. (Cambridge Univ. (GB). Inst. of Astronomy). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

Recent theoretical investigations have shown that there is a delicate balance between instability and stability mechanisms in certain stars when physical influences, such as convection and radiative transfer, are considered in a finer detail than in a typical pulsation computation. Baker and Gough (1979) and Xiong (1980) demonstrated the susceptibility of pulsations to stabilization towards the red edge of the RR Lyrae and Cepheid instability strips by a convection-pulsation coupling. Moreover, Christensen-Dalsgaard and Frandsen (1983) have illustrated the stabilizing effect of radiative transfer when it is included consistently in the calculation of a solar model. Here we extend the calculations of Baker and Gough to Cepheids and the sun.

23274 (ESA-SP—286, pp 67-72) **On the measurement of solar rotation using high-degree p-mode oscillations.** Woodard, M.F.; Libbrecht, K.G. (California Inst. of Tech., Pasadena, CA (US)). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

We describe the progress made and some of the difficulties encountered in measuring the solar rotation rate with p-modes of degree 100 <{similar←to} l <{similar←to} 400, using a set of high-resolution solar images taken at Big Bear Solar Observatory. The main conclusion drawn from an analysis of one day of data is that the equatorial angular velocity is essentially equal to the observed surface rate over the radius range $0.87 \leqq r/R \leqq 0.99$ to within a few percent. Because of likely systematic errors at the 1% level these data do not allow us to distinguish between a surface rotation rate equal to that measured using magnetic tracers and that based on the Doppler shift of photospheric spectral lines.

23275 (ESA-SP—286, pp 73-80) **Radial and latitudinal gradients in the solar internal angular velocity.** Rhodes, E.J.; Cacciani, A.; Korzennik, S.; Tomczyk, S.; Ulrich, R.K.; Woodard, M.F. (University of Southern California, Los Angeles (US); Jet Propulsion Lab. Pasadena, CA (US); Rome Univ. (IT). Ist. di Fisica; Jet Propulsion Lab. Pasadena, CA (US); University of Southern California, Los Angeles (US); California Univ. Los Angeles (US). Dept. of Astronomy; California Univ., Los Angeles (US). Dept. of Astronomy; California Inst. of Tech., Pasadena (US)). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

We recently presented the results of an analysis of the frequency splittings of intermediate-degree (3 < degree ≦ 170) p-mode oscillations which were obtained from a 16-day subset of our 1984 Mt. Wilson 60-foot tower observations. These results showed evidence for both radial and latitudinal gradients in the solar internal angular velocity. In particular, our results indicated that, from 0.6 R sun radius to 0.95 sun radius, the solar internal angular vecolity increases systematically from 440 to 463 nHz, corresponding to a positive radial gradient of {similar←to} 66 nHz/ sun radius for that portion of the solar interior. Our previous analysis also indicated that the latitudinal differential rotation gradient which is seen at the solar surface persists throughout the convection zone, although there was some indication that the differential rotation might disappear entirely below the base of the convection zone. Here we extend our previous analysis to include comparisons with additional observational studies and we also present comparisons between our earlier results and the results of additional inversions of several of the observational datasets.

23276 (ESA-SP—286, pp 81-86) **Initial high-degree p-mode frequency splittings from the 1988 Mt. Wilson 60-foot tower solar oscillation program.** Rhodes, E.J.,; Cacciani, A.; Korzennik, S. (University of Southern California, Los Angeles (US). Dept. of Astronomy; Jet Propulsion Lab., Pasadena, CA (US); Jet Propulsion Lab., Pasadena, CA (US); Rome Univ. (IT). Ist. di Fisica; University of Southern California, Los Angeles (US). Dept. of Astronomy; California Univ., Los Angeles (US). Dept. of Astronomy). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

We present here the initial frequency splitting results of solar p-mode oscillations which we have obtained from our 1988 helioseismology program at the Mt. Wilson Observatory. These frequency splittings correspond to the rotational splittings of sectoral harmonics which range in degree between 10 and 598. They were obtained from a cross-correlation analysis of the prograde and retrograde portions of a two-dimensional power spectrum. This power spectrum was computed from an eight-hour sequence. These frequency splittings have an inherently larger scatter than did the splittings obtained from our earlier 16-day power spectra. Consequently, the best we can say now is that these splittings are consistent with an internal solar rotational velocity which is independent of radius along the equatorial plane. The normalized frequency splittings averaged 449 +- 3 nHz, a value which is very close to the observed equatorial rotation rate of the photospheric gas of 451.7 nHz, (Ref.1).

23277 (ESA-SP—286, pp 87-90) **Radial and temporal structure of the internal solar asphericity.** Kuhn, J.R. (Michigan State Univ., East Lansing (US). Dept. of Physics and Astronomy). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

There are large systematic differences between the measured even-order splitting coefficients obtained from different helioseismic observations. These data were obtained by several groups, starting about 6 years ago, and used different observing techniques (e.g. Doppler vs. Intensity full disk solar observations) to derive the m-dependence of mode frequencies. Given the wide variation between the observation techniques it may not be surprising that the results differ - yet, I argued that the variation between datasets may be physically significant and directly related to solar cycle variations in the aspheric structure of the sun. This asphericity is not confined to the photosphere and is related to the solar cycle luminosity variations measured by ACRIM and the solar limb brightness observations.

23278 (ESA-SP—286, pp 91-98) **Solar rotation models and the a/sub 1/, a/sub 3/ and a/sub 5/ splitting coefficients for solar acoustic oscillations.** Morrow, C.A. (Cambridge Univ. (GB). Inst. of Astronomy). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

I present a forward analysis of the rotational frequency splittings of solar p-modes measured by Brown and Morrow to obtain information on the variation of the Sun's angular velocity with depth and co-latitude. This approach entails computing frequency splittings for chosen models of the solar rotation and comparing them to the observed splittings. It is called a forward method to contrast it with inversion techniques, which use the measured frequency splittings directly to produce a single function for the angular velocity. An advantage of the forward approach is that it allows one to develop intuition about the sensitivities of the splitting coefficients to various changes in the nature and magnitude of the angular velocity. The results of the preliminary analysis conducted in Morrow give the impression that models with surface rotation throughout the convection zone are more promising than models with angular velocity constant on cylinders. The more formal approach of this paper is able to substantiate this impression and to consider the splittings from a series of more elaborate models for the solar rotation.

23279 (ESA-SP—286, pp 99-102) **Is the sun really a rigid rotator.** Demarque, P.; Guenther, D.B. (Yale Univ., New Haven, CT (US)). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

Attention is drawn to observations of surface rotational periods in subgiants which indicate that a deep-seated reservoir of angular momentum must exist in these stars. This interpretation is compatible with theoretical studies of the rotational history of the Sun an sun-like stars, but is in apparent conflict with observations of p-mode splittings in the Sun. In order to understand better the source of this apparent discrepancy, we explore the predicted rotational splittings of several test rotation curves and compare them to the solar data. Finally, we discuss the implications of our findings for solar structure.

23280 (ESA-SP—286, pp 103-108) **Oscillation ring diagrams and the thermodynamics of the outer solar convection zone.** Hill, F. (Arizona Univ., Tucson (US). Optical Sciences Center). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

A recently developed three-dimensional Fourier analysis results in the appearance of rings in the power spectrum of solar oscillations. These rings are the cross-sections at constant temporal frequency of trumpet surfaces, and are the analog of the familiar ridges. The shape of the rings provides information on the local dispersion relationship of the oscillations expressed as a simple power law. The exponent and constant in the power law are related to the thermodynamics of the region in the solar interior where the waves propagate. Asymptotic expressions for high-degree modes, coupled with the assumption that the upper part of the solar envelope is an adiabatic polytrope, predict that the exponent should be 1/2. The constant should depend on the polytropic index of the envelope, and on a phase factor resulting from wave leakage. Analysis of over 5000 rings results in an observed exponent ranging between 0.3 and 0.6, a polytropic index between 1 and 7, and a phase factor between -1.5 and 5.

23281 (ESA-SP—286, pp 109-116) **Angular momentum transport and dynamo action in the sun: a report on implications of a recent helioseismic estimate of solar rotation.** Morrow, C.A.; Gilman, P.A.; DeLuca, E.E. (Cambridge Univ. (GB). Inst. of Astronomy; Colorado Univ., Boulder (US); Chicago Univ., IL (US)). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

Gilman, Morrow and DeLura have recently introduced some ideas about how an emerging helioseismic picture of the Sun's

internal rotation might affect the understanding of angular momentum transport and turbulent dynamo action in the solar interior. The present paper offers a brief report and commentary on these issues. Analysis of the frequency splittings of solar acoustic oscillations measured by Brown and Morrow has suggested that the latitudinal differential rotation observed at the surface persists throughout the convection zone, and that the rotation is more uniform in the outer layers of the radiative interior. Taking this picture at face value, we discuss qualitatively how angular momentum must be transported in order sustain the observed rotation, the exchange of angular momentum between the convection zone and radiative interior, and the action of a turbulent dynamo which might be operating near the base of the convection zone. Our new qualitative scenario for the solar dynamo explains both the equatorward migration of the zone where sunspots appear and the observed poleward migration of non-sunspot magnetic field.

23282 (ESA-SP—286, pp 117-124) **Inversion of the solar rotation rate versus depth and latitude.** Korzennik, S.G.; Rhodes, E.J., Jr.; Tomczyk, S.; Ulrich, R.K.; Cacciani, A. (University of Southern California, Los Angeles (US); California Univ. Los Angeles (US). Dept. of Astronomy; California Univ., Los Angeles (US). Dept. of Astronomy; Jet Propulsion Lab., Pasadena, CA (US); California Univ., Los Angeles (US). Dept. of Astronomy; Rome Univ. (IT). Ist di Fisica). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

We have used three different inversion techniques to compute the internal solar rotation rate from several sets of n-averaged frequency splittings. We have used an iterative variation of the spectral expansion method, the optimal averaging kernel method and a piecewise constant constrained least square method to invert the data. Each computation was carried out independently. While they present similar trends, each of the solutions differs in detail. A consistent feature in all the inversions is the disappearance of differential rotation below the base of the convection zone. Also, a strong differential signature in the deeper part of the convection zone is present in most of the solutions. A slow decrease of the rotation rate with depth for the equatorial and mid-latitude curves is significant in the spectral expansion and the least square results but only marginally apparent in the averaging kernel results.

23283 (ESA-SP—286, pp 125-130) **Rotational splitting of low l solar p-mode.** Palle, P.L.; Perez Hernandez, F.; Regulo, C.; Roca Cortes, T. Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

Rotational splitting measurements of p-modes are calculated using different sources of data. For data obtained from years 1981 to 1985 is used to find out the stretches where each particular mode remains excited, then its splitting is measured and the mean found. Cross-correlation of power spectra confirms these finding, and this method is used to look for the $l=2$ splitting. For $2<l<5$ only one month of data is available and superposition of peak structures gives an upper limit for their splitting.

23284 (ESA-SP—286, pp 131-136) **Solar p-mode frequency splittings.** Libbrecht, K.G. (California Inst. of Tech., Pasadena (US)). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

I discuss here new measurements of solar p-mode frequency splitting, based on 100 days of solar Doppler observations from Big Bear Solar Observatory. Because of the long observing run, the splitting measurements have significantly smaller uncertainties than previously published values. In addition, splittings were determined accurately for individual mode multiplets for the first time, and show a dependence of splitting on radial order n as well as degree l.

23285 (ESA-SP—286, pp 137-140) **Way to examine rotational splittings without explicit forward or inverse computations.** Morrow, C.A. (Cambridge Univ. (GB). Inst. of Astronomy). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

I derive and demonstrate simple but useful techniques for extracting information about the Sun's internal rotation from the observed frequency splittings of solar acoustic oscillations. The techniques do not require any formal forward or inverse computations and yet are significantly revealing about the radial and latitudinal variations of solar angular velocity reflected by the data. Simple linear combinations of the familiar rotational splitting coefficients, allow one to gain an impression of how any chosen co-latitudinal average of the angular velocity varies with depth, or of the radial variation of angular velocity at any particular co-latitude. The techniques are easy to apply and I illustrate them using the data of Brown and Morrow; they are equally applicable to data published by others. For the Brown and Morrow data, the methods reveal a lack of a substantial radial gradient of angular velocity in the convection zone, and a reversal in the sign of the radial gradient of angular velocity at about 30 degrees latitude at depths near the base of the convection zone. When subject to more detailed forward and inverse analysis, these data have also suggested such characteristics of the solar internal angular velocity. This lends credence to the methods described here.

23286 (ESA-SP—286, pp 141-148) **Measurement of the rotational frequency splitting of the solar five-minute oscillations from magneto-optical filter observations.** Tomczyk, S.; Korzennik, S.G.; Ulrich, R.K.; Rhodes, E.J., Jr.; Cacciani, A. (California Univ., Los Angeles (US); Southern California Edison Co., Los Angeles (US); Rome Univ. (IT)). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

Observations of the solar five-minute oscillations in the photospheric velocity field were obtained during the summer of 1984 at the 60-foot solar tower of the Mt. Wilson Observatory with a magneto-optical filter. The magneto-optical filter employs magneto-optical effects in an atomic vapor to isolate narrow bandpasses in alternate wings of a spectral line. A subset of two time series from this data of 16 and 19 days duration having a total of 25744 doppler images were analyzed to provide estimates of the rotational frequency splitting for spherical harmonic degrees between 5 and 120. The results of this analysis indicate a decrease in the rate of solar rotation with increasing depth inside the sun. Also, a decrease in the rate of differential rotation with increasing depth is observed.

23287 (ESA-SP—286, pp 149-162) **Differential rotation in the solar interior.** Christensen-Dalsgaard, J.; Schou, J. (Aarhus Univ. (DK). Inst. of Astronomy). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

We present an estimate of the angular velocity in the outer half of the Sun, as a function of depth and latitude. This was obtained by applying inversion by means of optimally localized averages to rotational splitting coefficients observed by Ken Libbrecht at BBSO. The results seem to indicate that the surface differential rotation persists through the convection zone; beneath the convection zone there appears to be a transition, which occurs within our resolution width of about 0.1R, to solid-body rotation. We were unable to perform the inversion in the core, due to the lack of adequate data for modes of low degree.

23288 (ESA-SP—286, pp 163-176) **Solar luminosity oscillations from two stations and correlation with velocity measurements.** Jimenez, A.; Palle, P.L.; Andersen, N.B.; Domingo, V.; Jones, A.; Alvarez, M.; Ledezma, E. (Instituto de Astrofisica de Canarias, Tenerife (ES); European Space Research and Technology Centre, Noordwijk (NL); Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Astronomia). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

Since 1984 the measurements of a quadruple photometer sited at the Observatorio del Teide (Izana, Tenerife) have made it possible to identify the p-mode luminosity spectrum with simultaneous velocity observations. Comparing this data, the adiabatic behaviour of solar atmosphere and theoretical expectations from solar models have been tested. Now, in order to increase the signal-to-noise ratio and reduce the sidebands due to the night-time data gaps, a second identical photometer was set-up in December 1987, at the Observatorio de San Pedro Martir (Baja California Norte, Mexico). The first results of the observations of these two stations are analyzed and compared with simultaneous velocity measurements.

23289 (ESA-SP—286, pp 177-194) **Effect of atmospheric extinction on solar radial velocity measurements.** Belmonte, J.A.; Palle, P.L.; Roca Cortes, T.; Elsworth Y.; Isaak, G.R.; New, R. (Instituto de Astrofisica de Canarias, Tenerife (ES); Birmingham Univ. (GB). Dept. of Physics). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

Differential extinction across the Earth's atmosphere affects astronomical photometry in a well known way. Under the same circumstances when a rotating extended object is observed spectrometrically, a residual radial velocity is obtained which varies during the day. In the case of integral sunlight observations, this effect has been calculated along the day in all possible observing situations during the year. Applications to real observations are shown and discussed leading to some conclusions specially relevant to ground-based networks.

23290 (ESA-SP—286, pp 195-234) **Attempt to understand the Stanford p-mode data.** Gough, D.O.; Kosovichev, A.G. (Cambridge Univ. (GB). Inst. of Astronomy; Crimean Astrophysical Observatory, Nauchny (SU)). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

The p-mode frequencies exhibit anomalous behaviour at degree 5 and frequencies below 2 mHz. We have investigated the implications of these data, and find no plausible solar model that is consistent with them. A density inversion including the low-degree five-minute data of Jimenez et al. (1988) implies that the density of the solar core is some 10 per cent greater than it is in the standard solar model 1 of Christensen-Dalsgaard (1982). Although that result is in keeping with previous suggestions either that the sun has a greater evolutionary age than is usually supposed or that there is a cloud of weakly interacting massive particles in the solar core and its environs, the behaviour of the sound speed in the core is not consistent with either hypothesis. Both the inferred sound-speed variation, and a secondary inversion for hydrogen abundance, provide some evidence for material redistribution in the energy-generating core. A sound-speed inversion for the entire radiative interior, using also frequencies of low and intermediate degree, confirms the earlier finding that the sound speed in the sun exceeds that of a standard solar model by up to 1 per cent in a region extending some 30 per cent of the solar radius and centred at $r \simeq 0.4R$. That is consistent with, though does not necessarily imply, that the opacity in the outer layers of the radiative interior at temperatures of up to about 4 x 10/sup 6/K has been underestimated by some 20 per cent.

23291 (ESA-SP—286, pp 235-240) **Measurements of solar oscillations at 37 GHz.** Teraesranta, H.; Urpo, S.; Pohjolainen, S.; Leskinen, E.L. Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

We present 37 GHz observations of solar oscillations made during August 1983 and May 1988 at Metsaehovi Radio Research Station. Altogether we had data from ten clear days which could be used for further analysis. Five quiet regions were selected from the Sun and the amplitude differencies were monitored during the day. Due to large amount of data only typical examples are presented. During favourable conditions the amplitude at the period of 160 minutes would increase in respect with the other peaks in the power spectrum. The data would also give some suggestions that a higher degree g-mode oscillation $l \geqq 5$ could be possible.

23292 (ESA-SP—286, pp 305-310) **Viscous magnetohydrodynamic modes and p-mode absorption by sunspots.** Lou, Yu Qing. (National Center for Atmospheric Research, Boulder, CO (US); Heidelberg Univ. (DE). Inst. fuer Theoretische Astrophysik). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

We investigate properties of small compressible magnetohydrodynamic (MHD) perturbations in the presence of viscosities. Background physical variables in static equilibrium are assumed to vary continuously only with radial coordinate in cylindrical geometry. The well-known ideal MHD singularities are removed by viscosities. We discuss novel features of viscous MHD modes and the viscous diffusive mode conversion process. It is shown that this diffusive mode conversion process can be very effective in the presence of MHD singular layers. We suggest a possible mechanism relevant to the observed p-mode absorption by sunspots in the solar atmosphere. An upper limit for turbulent viscosity is inferred from the observed linewidths of p-modes.

23293 (ESA-SP—286, pp 311-314) **Influence of a chromospheric magnetic field on p- and f-modes.** Roberts, B.; Campbell, W.R. (Saint Andrews Univ. (GB). Dept. of Mathematical Sciences). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

The influence of a magnetic chromosphere on p- and f-modes of oscillation is explored theoretically, modelling the chromosphere by an isothermal atmosphere permeated by a horizontal magnetic field and the field-free convection zone by a polytrope. It is pointed out that active regions, characterized by magnetic field strengths of the order of 100 gauss, have a significant effect on the frequencies of high degree modes. The frequency of the f-mode is increased by the presence of a magnetic field; the frequencies of p-modes are decreased. In an evolving active region the frequencies of high degree p- and f-modes are systematically split apart by the changing magnetic field. These effects should be apparent in a comparison of high resolution data sets for active regions with either low resolution sets or high resolutions sets for quiet regions.

23294 (ESA-SP—286, pp 315-320) **Observations of f- and p-mode oscillations of high degree ($500 < l < 2500$) in quiet and active sun.** Tarbell, T.; Peri, M.; Frank, Z.; Shine, R.; Title, A. (Lockheed Palo Alto Research Labs., CA (US)). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

This poster presents spectra (l - ν diagrams) from high resolution observations taken at the Vacuum Tower Telescope (NSO/Sunspot). The raw data are CCD images taken through the SOUP narrowband filter in Fe I 5576 A. Four filtergrams spaced through the spectral line are combined to form velocity movies. Spectra for 80 minutes of data with 0.5 - 1.5 arcsecond resolution are presented

for the entire field-of-view and for quiet and magnetic subregions. Ridges f and p/sub 1/ - p/sub 5/ are evident in velocity spectra, extending to l = 2500 (f), l = 1800 (p/sub 1/), and l = 1200 (p/sub 2/). Much less power is seen in the magnetic region than in the quiet sun. Three-dimensional Fourier filtering shows that oscillation velocity amplitude drops sharply at the boundary of the active region for each family of modes considered.

23295 (ESA-SP—286, pp 321-324) **Evidence for a thin perturbative layer near the base of the solar convection zone.** Thompson, M.J. (High Altitude Observatory, National Centre for Atmospheric Research, Boulder, CO (US)). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

Low-degree solar p-mode frequencies hint at the presence of a thin perturbative layer at the base of the Sun's convection zone. Magnetic flux stored in an overshoot region could constitute such a perturbative layer.

23296 (ESA-SP—286, pp 325-332) **Magnetically induced spectral line redshifts full disk measurements.** Ulrich, R.K.; Boyden, J.E.; Webster, L.; Shieber, T. (California Univ., Los Angeles (US). Dept. of Astronomy). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

Regions on the sun with higher than average magnetic field strength are known to be associated with apparent downdrafts. Asymmetries in the Stokes V line profiles are related to the apparent doppler shifts in observing systems which measure the spectrum in a pair of pass-bands centered on the spectral line. These shifts can contaminate the observed solar velocity and interfere with the detection of low amplitude, long period oscillations. We describe here a method which will allow the calibration of the magnetically induced velocities and permit an improvement of the information from various planned solar oscillation experiments. Based on the differential sensitivity to the magnetic effects of various spectral lines we derive a correction function giving the doppler shift in each line as a function of the difference between shifts of the lines.

23297 (ESA-SP—286, pp 333-338) **Dynamo theory prediction of solar activity.** Schatten, K.H. (National Aeronautics and Space Administration, Greenbelt, MD (US). Goddard Space Flight Center). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

A "dynamo theory" technique appears to successfully predict decadal time scale solar activity variations. The technique was developed a decade ago, following some puzzling correlations involved with geomagnetic "precursors" of solar activity. Based upon this, a dynamo theory method was developed to predict solar activity. The method was used successfully in solar cycle. We now see sunspot numbers increasing at an alarming rate and realize (1) that a large cycle is developing and (2) that the cycle may even surpass the largest cycle-19. We use a "Sporer Butterfly" method to show that the cycle can now be expected to peak in the latter half of 1989, consistent with an amplitude comparable to our value predicted near the last solar minimum.

23298 (ESA-SP—286, pp 339-358) **Long period solar oscillations.** Raay van der, H.B. (Birmingham Univ. (GB)). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

Several years of high quality optical resonant scattering data from full disk solar observations are analysed to demonstrate the essential stability of the apparatus necessary to extract signals of periods hours, days or possibly years. The variation of the gravitational red shift is examined, the 13 day signal occasioned by solar surface inhomogenuities is demonstrated and the 160 min signal in these data is shown to be an artifact. Finally the g modes extracted from these data are shown to be stable in period over the interval 1981 to 1987. Interpreted in terms of the Tassoul asymptotic relation a value of T/sub 0/ = 41.2 min is found which would tend to favour a solar model with mixing.

23299 (ESA-SP—286, pp 359-362) **IPHIR: the Helioseismology experiment on the PHOBOS mission.** Bonnet, R.M.; Bruns, A.V.; Kotov, V.A.; Rashkovsky, D.N.; Delaboudiniere, J.P.; Toutain, T.; Vial, J.C.; Domingo, V.; Kollath, Z.; Froehlich, C. (European Space Agency, 75 - Paris (FR); Crimean Astrophysical Observatory Nauchny (SU); Laboratoire de Physique Stellaire et Planetaire, 91 - Verrieres-le-Buisson (FR); European Space Research and Technology Centre, Noordwijk (NL); Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Dec 1988. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88757349/JAW. (CONF-8809146—).

From Seismology of the sun and sun-like stars; Puerto de la Cruz, Spain (26 Sep 1988).

IPHIR (Inter Planetary Helioseismology by IRradiance measurements) is a solar irradiance experiment on the USSR planetary mission PHOBOS to Mars and its satellite Phobos. The sensor is a three channel sunphotometer (SPM) which measures the solar spectral irradiance at 335, 500 and 865 nm with a precision of better than 1 ppm. A two axis solar sensor (TASS) is added to monitor the moderate solar pointing of the spacecraft. A microprocessor based data processing unit controls the sensor operation, acquires the data and performs the data compression for the transmission at a mean rate of 1 bit/s. The two spacecrafts have been launched on July 7th and 12th, 1988. The experiment on PHOBOS I gathered data during 45 days before the S/C was lost, the one on PHOBOS II is still operating. The data recovery is excellent with virtually 100 percent coverage.

23300 **(KEK-PR—88-1) Proceedings of the second workshop on elementary-particle picture of the universe.** Yoshimura, Motohiko; Totsuka, Yoji; Nakamura, Kenzo; Lim, Chkong-Sa (eds.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). 1988. Vp. (CONF-8802136—). NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780073/JAW.

From 2. workshop on elementary-particle picture of the universe; Tsukuba, Japan (4 Feb 1988).

Individual papers are indexed separately.

23301 **(LA-UR—89-406) Observation of Hercules X-1 at energies above 50 TeV.** Dingus, B.L.; Chang, C.Y.; Goodman, J.A.; Gupta, S.K.; Haines, T.J.; Krakauer, D.A.; Talaga, R.L.; Ellsworth, R.W.; Burman, R.L.; Butterfield, K.B. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 4p. (CONF-8808145—28). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007745/JAW.

From Meeting of the Division of Particles and Fields of the American Physical Society (APS); Storrs, CT, USA (15 Aug 1988).

A search for emission from Hercules X-1 at energies above 50 TeV during the calendar period April 1986 to July 1987 yielded two significant bursts, on UT 24 July 1986. The events during these bursts were pulsed with a period of 1.2357 s, significantly different from estimates of the contemporaneous x-ray period. The probability that this represents random statistical fluctuations of the background is estimated to be 1/70000. The muon content of the burst events is anomalous when compared with expectations from gamma-ray showers. 11 refs., 1 fig.

23302 **(LA-UR—89-598) An ultra-soft Einstein x-ray survey.** Cordova, F.A.; Kartje, J.; Rodriguez-Bell, T.; Mason, K.O.; Harnden, F.R. Jr. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 14p. (CONF-890189—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007993/JAW.

From Berkeley colloquium on extreme ultraviolet astronomy; Berkeley, CA, USA (19 Jan 1989).

We describe preliminary results of a survey of ultra-soft sources using the data base acquired with the Imaging Proportional Counter on the Einstein Observatory. Of the {approximately}7700

detections of sources in this data base with signal-to-noise ratios ≧ 3 in the energy band 0.16--3.5 keV, {approximately}3% fit the selection criteria for sources that may have extremely soft x-ray components; i.e., they have a very low ratio of medium energy band (0.56--1.08 keV) to soft energy band (0.16--0.56 keV) counts. Preliminary results of our searches for counterparts of the ultra-soft sources, done with catalogs and optical and radio observations, reveal that the Ultra-Soft Survey is populated by, among other objects, isolated degenerate dwarf stars, particular subclasses of cataclysmic variable binaries, low-mass x-ray binaries in the LMC, some SAO stars of late spectral type, and several Hyades and dMe stars. With observations utilizing the Very Large Array, we identified one bright, Ultra-Soft Survey object with the radio pulsar PSR 0656 + 14. A particularly exciting result is the finding, thus far, of numerous active galactic nuclei among the Ultra-Soft Survey sources. Two-thirds of these AGN do not have any detectable x-ray emission above 1 keV. The remainder appear to have both an ultra-soft and a hard component. The soft component can be characterized by a power law with an energy spectral index, α/sub E/, > 2. The soft AGN are mostly low-redshift sources with V magnitudes ranging from 17 to 20. All of these AGN are viewed along lines of sight in which the equivalent hydrogen column density is less than 6 {times} 10^{20} cm/sup {minus}2/. We present a table of the Ultra-Soft Survey sources for which we have identified probable optical counterparts. These objects presage the classes of source that EUVE and the Wide-Field Camera on ROSAT are likely to find in their all-sky, extreme ultraviolet surveys. 21 refs., 6 figs., 1 tab.

23303 **(LA-UR—89-639) A search for EUV emission from cataclysmic variables.** Polidan, R.S.; Mauche, C.W. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 13p. (CONF-890189—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008012/JAW.

From Berkeley colloquium on extreme ultraviolet astronomy; Berkeley, CA, USA (19 Jan 1989).

Voyager far- and extreme-ultraviolet (500--1200 {angstrom}) spectrophotometric observations of five cataclysmic variables (the dwarf novae SS Cyg and VW Hyi and the novalike variables V3885 Sgr, RW Sex, and IX Vel) are combined with neutral hydrogen column densities derived from the curve-of-growth analysis of interstellar absorption lines in high-resolution IUE spectra to place upper limits on the emitted flux in the 600--700 {angstrom} EUV band. No EUV emission was observed in any of the five cataclysmic variables. Relatively high neutral hydrogen column densities (> 10^{19} cm/sup {minus}2/) in SS Cyg, V3885 Sgr, RW Sex, and IX Vel preclude any discussion of their intrinsic EUV emission. For VW Hyi, the low neutral hydrogen column, and excellent Voyager data place severe upper limits on the intrinsic EUV flux of this cataclysmic variable. The derived EUV limits for VW Hyi are compared to predictions from various models and Voyager observations of EUV emission from nearby hot white dwarfs. 8 refs., 2 figs., 2 tabs.

23304 **(LA-UR—89-1077) The ALEXIS project and the local interstellar medium.** Bloch, J.J.; Smith, B.W. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 10p. (CONF-890189—6). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009246/JAW.

From Berkeley colloquium on extreme ultraviolet astronomy; Berkeley, CA, USA (19 Jan 1989).

The ALEXIS satellite will be a valuable tool for studying the diffuse soft X-ray background (SXRB). The SXRB emission (0.07--0.25 keV) is thought to originate in a plasma at about 10^6K that exists in the local interstellar medium. Emission models of such a plasma (Raymond and Smith 1977, 1987) with normal cosmic elemental abundances predict that about 34% of the atomic cooling power comes from a set of closely-spaced lines around 70 eV from Fe VII through XII. Two passbands of the ALEXIS telescopes will be centered at 66 and 72 eV to include the Fe line emission. The flux from these lines in the SXRB could produce a signal of as much as 150 counts per second for ALEXIS telescopes with these passbands. With the narrow spectral response of the ALEXIS telescopes, an unambiguous measurement of the flux from the lines will be possible. When combined with other data sets, the intensities of the SXRB in the 66 and 72 eV bands allow distinction between models of emission from hot gas having normal and depleted abundances. ALEXIS' spatial resolution and estimated year-long operating lifetime will allow the generation of all-sky maps of the SXRB in these Fe lines with about one degree resolution and considerable sensitivity. These maps will be more sensitive to absorption features due to nearby low-column-density clouds than maps done in higher energy bands. 13 refs., 3 figs., 4 tabs.

23305 **(LA-UR—89-1110) On the measurement of cosmogenic nuclides in cometary materials.** Herzog, G.F.; Englert, P.A.J.; Reedy, R.C.; Nishiizumi, K.; Kohl, C.P.; Arnold, J.R. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 15p. (CONF-890195—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009248/JAW.

From Workshop on the analysis of returned comet nucleus samples; Milpitas, CA, USA (16 Jan 1989).

Determinations of the cosmogenic nuclide concentrations in cometary material will help to define the recent surface history of the comet and its exposure to cosmic rays. In particular, the rates for the removal or mixing of surface material could be studied, and any variations in cosmic-ray intensity implied by the data could be used to infer orbital changes during the last few million years. The measurement of the shorter-lived isotopes poses technical challenges that should be addressed now. The measurement of longer-lived isotopes will be straightforward provided that rates of mass loss are not too high. 46 refs., 2 figs.

23306 **(RRK—88-28) Diagrammatic derivation of Coleman's vanishing cosmological constant.** Hosoya, Akio. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Sep 1988. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757285/JAW.

We present an alternative derivation of Coleman's expression for cosmological constant by summing over topologies of spacetime in the wormhole dominance approximation. It is pointed out that the correlation between disconnected spaces, if any, vanishes by Coleman's mechanism.

23307 **(RRK—88-37) Gravitational angular fluctuations of the cosmic background radiation produced by cosmological linear perturbations.** Tomita, Kenji. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Nov 1988. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757287/JAW.

The gravitational angular fluctuations of light rays produced by linear density perturbations are investigated in the Einstein-de Sitter model. It is shown that, owing to the random-walk process aroused by the perturbations, the mean square of relative angular fluctuations of two neighbouring light rays increase as they propagate. If the density contrast is larger than 3 x 10/sup -3/ for the present size 30 Mpc, the angular fluctuations for the angle difference of several minutes are so large to play a role to decrease the small-scale anisotropy of the cosmic background radiation during the propagation from the decoupling epoch to the present. They may give us also a reason to the question why few quasars can be found for z > 4.

23308 **(UCRL—100343) Compact source origin of cosmic ray antiprotons.** Dermer, C.D. (Lawrence Livermore National Lab., CA (USA)). Feb 1989. Contract W-7405-ENG-48. 5p. (CONF-881212—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008044/JAW.

From Particle astrophysics workshop; Berkeley, CA, USA (8 Dec 1988).

The flux of cosmic ray antiprotons with kinetic energies between {approximately}1 and 15 GeV is {approximately}5 times greater than the flux predicted on the basis of the leaky-box model. This excess is attributed to secondary antineutron production in compact sources. Because the antineutrons are not confined by the magnetic field of the compact source, they leave the interaction site, decay in interstellar space and account for the apparent excess cosmic ray antiproton flux. The escape and decay of neutrons produced in association with the antineutrons is a source of cosmic ray protons. Observations of the angular variation of the intensity and

spectral shape of 100 MeV γ-rays produced by neutron-decay protons in the reaction $p + p \rightarrow \pi^0 \rightarrow 2\gamma$ could reveal compact-source cosmic ray production sites. COS-B observations of spectral hardening near point sources, and future high-resolution observations of galactic point sources by Gamma-1 and the Egret telescope onboard the Gamma Ray Observatory may provide supporting evidence for this model. 12 refs., 2 figs.

23309 **Cosmological cosmic strings.** Gregory, R. (N.A.S.A./Fermilab Astrophysics Center, Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 8, 2108-2114(15 Apr 1989).

We investigate the effect of an infinite cosmic string on a cosmological background. We find that the metric is approximately a scaled version of the empty-space string metric, i.e., conical in nature. We use our results to place bounds on the amount of cylindrical gravitational radiation currently emitted by such a string. We then analyze explicitly the gravitational radiation equations and show that even initially large disturbances are rapidly damped as the expansion proceeds. The implications for the gravitational radiation background and the limitations of the quadrupole formula are discussed.

23310 **Universe creation from the third-quantized vacuum.** McGuigan, M. (The Rockefeller University, 1230 York Avenue, New York, New York 10021). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 8, 2229-2233(15 Apr 1989).

Third quantization leads to a Hilbert space containing a third-quantized vacuum in which no universes are present as well as multiuniverse states. We consider the possibility of universe creation for the special case where the universe emerges in a no-particle state. The probability of such a creation is computed from both the path-integral and operator formalisms.

23311 **Quantum chaos in the mixmaster universe.** Berger, B.K. (Physics Department, Oakland University, Rochester, Michigan 48309). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 8, 2426-2429(15 Apr 1989).

A Monte Carlo simulation of the vacuum Bianchi type-IX (mixmaster) cosmology yields a significant correlation between large universe volume and high anisotropy. An analog of the model's chaotic classical behavior is seen in the break up of the universe wave function at large volume into fingers in the corners of the minisuperspace anisotropy potential.

23312 **Primordial lithium and the standard model(s).** Deliyannis, C.P.; Demarque, P.; Kawaler, S.D.; Krauss, L.M.; Romanelli, P. (Center for Theoretical Physics, and Department of Astronomy and Center for Solar and Space Research, Yale University, New Haven, Connecticut 06511). *Physical Review Letters;* **62**: No. 14, 1583-1586(3 Apr 1989).

We present the results of new theoretical work on surface ^{7}Li and ^{6}Li evolution in the oldest halo stars along with a new and refined analysis of the predicted primordial lithium abundance resulting from big-bang nucleosynthesis. This allows us to determine the constraints which can be imposed upon cosmology by a consideration of primordial lithium using both standard big-bang and standard stellar-evolution models. Such considerations lead to a constraint on the baryon density today of $0.0044 < \Omega/\text{sub b}/h^2 < 0.025$ (where the Hubble constant is 100h Km sec/sup -1/ Mpc /sup -1/), and impose limitations on alternative nucleosynthesis scenarios.

23313 **Test of equivalence principle for neutrinos and antineutrinos.** Pakvasa, S.; Simmons, W.A.; Weiler, T.J. (Department of Physics and Astronomy, University of Hawaii at Manoa, Honolulu, Hawaii 96822). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 6, 1761-1763(15 Mar 1989).

Based on data from the supernova SN 1987A it is shown that the Einstein equivalence principle is confirmed for electron neutrinos and their antiparticles to one part per million provided at least one of the events is due to ν/sub e/e scattering. Bounds on the strengths of new galactic-range forces coupling to neutrinos (of nonzero mass) and to matter are also deduced.

23314 **Approximate stress-energy tensor for evaporating black holes.** Vaz, C. (Department of Physics and Astronomy, Johns Hopkins University, Baltimore, Maryland 21218). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 6, 1776-1779(15 Mar 1989).

We approximate the Israel-Hartle-Hawking and Unruh stress-energy tensors of quantum fields in the neighborhood of a static Schwarzschild black hole. The approximate tensors are constructed from the conservation equations in the ultrastatic optical metric of the black hole and the expected regularity properties at the horizon, in the respective vacua. Our scheme reproduces the approximation of Page, Brown, and Ottewill for the Israel-Hartle-Hawking vacuum and yields a tensor for the Unruh state. The latter exhibits the correct behavior at infinity and predicts luminosities in good agreement with numerical calculations.

23315 **Initial conditions for $R+\epsilon R^2$ cosmology.** Mijic, M.B.; Morris, M.S.; Suen, W.M. (Physics Department, The University of British Columbia, Vancouver, British Columbia, Canada V6T{vert←bar}2A6 and Theoretical Physics Laboratory, The Boris Kidric Institute of Nuclear Sciences, Belgrade, Yugoslavia). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 6, 1496-1510(15 Mar 1989).

A pure gravity cosmology based on the $R+\epsilon R^2$ Lagrangian is known to exhibit inflation for a wide range of initial conditions. In this paper we use the wave function from quantum cosmology to describe this inflation as a chaotic inflationary phase immediately following the quantum creation of the Universe. We evaluate, compare, and discuss the distributions over initial conditions that are fixed by the two boundary-condition proposals of Hartle and Hawking ("no boundary") and Vilenkin ("tunneling from nothing"). We find that among all classical inflationary trajectories that begin on the classical-quantum boundary, those that lead to an inflation of at least 70 e-foldings make up a fraction of {similar←to}exp(-10/sup 12/) in the former case and {similar←to}1-exp(-8 x 10/sup 10/) in the latter. Thus, in the simplest interpretation, the observable Universe would be the outcome of a rare event for the first boundary-condition proposal and a typical event for the second.

23316 **Cosmology of biased discrete symmetry breaking.** Gelmini, G.B.; Gleiser, M.; Kolb, E.W. (International Center for Theoretical Physics, and International School for Advanced Studies, Box 586, 34100 Trieste, Italy). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 6, 1558-1566(15 Mar 1989).

We study the cosmological consequences of spontaneous breaking of an approximate discrete symmetry. The breaking leads to the formation of protodomains of false and true vacuums separated by domain walls of thicknesses determined by the mass scale of the model. The cosmological evolution of the walls is extremely sensitive to the magnitude of the biasing; several scenarios are possible, depending on the interplay between the surface tension on the walls and the volume pressure from the biasing. Walls may disappear almost immediately after they form, or may live long enough to dominate the energy density of the Universe and cause power-law inflation. We obtain limits on the biasing that characterize each possible scenario.

23317 **Test of magnetic field draping induced B/sub z/ perturbations ahead of fast coronal mass ejecta.** McComas, D.J.; Gosling, J.T.; Bame, S.J.; Smith, E.J.; Cane, H.V. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **94**: No. A2, 1465-1471(1 Feb 1989).

Recent studies have suggested that the ambient interplanetary magnetic field (IMF) drapes about fast coronal mass ejections (CMEs) as they plow out through slower moving, quiescent solar wind. In this study we examine ISEE 3 plasma and magnetic field data in order to look for observational evidence of IMF draping ahead of fast CMEs. Since the upstream IMF is excluded from CMEs, the ambient field must drape about these ejecta and connect back to the Sun around their edges. For example, for a purely radial, inward directed IMF, this would mean taht a CME which extends into the ecliptic plane while being directed northward of its hould give rise to a southward B/sub z/ perturbation in the ecliptic

plane ahead of the CME. While purely radial IMF configurations are rare, the radial component of the IMF should also give rise to such B/sub z/ perturbations.

23318 **Overview of non-accelerator physics.** Marshak, M.L. (School of Physics and Astronomy, University of Minnesota, Minneapolis MN 55455). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 144-156(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The study of very high energy (VHE) and ultrahigh (UHE) energy quanta from specific astrophysical sources may yield otherwise unobtainable information about processes in the macroscopic particle physics laboratory environment of a neutron star. Considerable existing data indicate that such quanta have already been observed. However, some data suggest that primaries from at least two neutron stars behave according to unknown physics mechanisms.

23319 **Type II supernovae: How do they explode?.** Baron, E. (Dept. of Physics, SUNY, Stony Brook, NY 11794-3800). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 976-981(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

I discuss what has been learned from the neutrino observations of Supernova 1987A. The neutrino detections confirmed our basic theoretical scenario that Type II supernovae involve the gravitational collapse of a massive star. The small number of events makes it difficult to infer details about the actual mechanism of collapse. I discuss the current theoretical situation on the mechanism of explosion.

6402 Atmospheric Physics

23320 **Long-time evolution of a low-density ion beam.** Zachary, A.L.; Cohen, B.I.; Max, C.E.; Arons, J. (Department of Astronomy and Astrophysics, University of Chicago, Illinois). *Journal of Geophysical Research;* **94**: No. A3, 2443-2458(1 Mar 1989).

With a new, orbit-averaged hybrid computer simulation code, we study a cold, fast low-density ion beam which propagates along the ambient magnetic field as it interacts with a much denser fluid background. We examine the character of the interactions as we vary the ion beam density relative to the background density over the range 1 x 10/sup -5/ to 3 x 10/sup -3/. The low beam density simulations may not be directly observable upstream of the Earth's bow shock, but they are included to help develop an understanding of the results seen in the simulations with high-beam density. However, our highest density simulation falls within the range of solar wind data. All the simulations, regardless of the relative beam density, show three distinct phases: (1) an early or "linear" phase; (2) an intermediate or "trapping" phase; and (3) a late or "decorrelation" phase. In the early phase, the beam excites a nearly monochromatic Alfven wave whose amplitude grows exponentially at a rate given by linear perturbation theory. The wave amplitude saturates when the linear growth rate is of the order of the trapping frequency.

23321 **Nonlocal theory of long-wavelength plasma waves associated with sporadic E layers.** Riggin, D.; Kadish, A. (Atmospheric Sciences Group, Earth and Space Sciences Division, Los Alamos National Laboratory, New Mexico). *Journal of Geophysical Research;* **94**: No. A2, 1495-1500(1 Feb 1989).

In this paper we calculate the nonlocal growth rate of gradient drift plasma waves under conditions where the electron density gradient scale length changes with altitude. The results are compared with the local growth rate and discussed in the context of the kilometer-scale waves which have been observed in the vicinity of mid-latitude sporadic E layers. These large-scale waves drastically violate the local approximation, kL/sub m/$>>$1, where k is the irregularity wave number and L/sub m/ is the minimum gradient scale length on the edge of a layer. The first step in the analysis is to derive a general eigenmode equation, starting with the same assumptions usually used in the derivation of the local dispersion relation for long wavelength waves. Modeling a sporadic E layer as a slab, the nonlocal growth rate spectrum is found by solving the eigenmode equation for this profile. The solution is an algebraic dispersion relation with a growth rate spectrum which is roughly proportional to k, rather than the k^2 dependence predicted by conventional local theory at long wavelengths. At short wavelengths the nonlocal growth rate determined with the slab is unbounded, in disagreement with local theory. The slab is an inadequate model for short wavelength waves and a bound on the growth rate is instead derived from a theory which can be applied to any realistic profile with nonzero L/sub m/. At short wavelengths this bound is identical to the local growth rate expression, while at long wavelengths the bound remains proportional to k and thus is consistent with the dispersion relation for a slab. Nonlocal effects alone do not explain the dominance of kilometer scales, but they do tend to favor the excitation of long wavelengths.

23322 **Comment on "Large-scale response of the magnetosphere to a southward turning of the interplanetary magnetic field" by J. A. Sauvaud et al.** Gonzalez, W.D.; Gonzalez, A.L.C.; Tsurutani, B.T. (Instituto de Pesquisas Espaciais, Sa-tildeo Jose dos Campos, Sa-tildeo Paulo, Brazil). *Journal of Geophysical Research;* **94**: No. A2, 1547-1548(1 Feb 1989).

The magnetospheric energization and the auroral electrojet intensification, according to Sauvaud et al. [1987] can be explained by the coupling function. The authors contend that ϵ does not necessarily represent well the above phenomena. (AIP)

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 22661, 22681, 22691, 22801, 23564, 23743

23323 **(ANL/PPRNT—89-137) Low-temperature ion beam mixing in metals.** Kim, S.J.; Nicolet, M.A.; Averback, R.S.; Peak, D. (Argonne National Lab., IL (USA)). Oct 1986. Contract W-31109-ENG-38. 31p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008345/JAW.

A systematic study of ion beam mixing of tracer impurities in thin metal films at low temperatures has been conducted. We have investigated the dependence of ion mixing on two matrix properties: atomic mass and cohesive energy. We have also studied the dependence of ion mixing on tracer impurity properties: its heat of mixing with the matrix and its thermal diffusivity in the matrix. The matrices investigated were thin films of C, Al, Ti, Fe, Ni, Cu,Mo, Ru, Ag, Hf, Ta, W, Pt, and Au. The tracer impurities, Al, Ti, Cr, Mn, Fe, Ni, Cu, Y, Nb, Mo, Ru, Ag, In, Sb, Hf, Ta, W, Pt, Au, and Bi were deposited as $\leqq$15 {angstrom} layers near the midplanes of the specimens, i.e., in the "marker geometry." All the tracer and matrix elements, except C, were deposited sequentially, without breaking vacuum. The samples were irradiated with 300--1000 keV Kr ions to doses 10^{15}--10^{16} ions/cm^2 at temperatures of 6 and/or 77 K. Most samples were analyzed at the irradiation temperature by He backscattering. A strong correlation between ion mixing and the matrix properties, atomic mass and cohesive energy, was observed. A correlation between ion mixing and tracer impurity diffusion was also observed but not between ion mixing and the heat of mixing or mass of the impurity with the matrix. The results are interpreted within the framework of a thermal spike model of cascade diffusion. 41 refs., 6 figs., 5 tabs.

23324 **(BNL—42160) Nonresonant multiphoton ionization of alkaline earth atoms with intense 532 nm and 1064 nm radiation.** DiMauro, L.F.; Kim, D. (Brookhaven National Lab., Upton, NY (USA)). 1989. Contract AC02-76CH00016. 5p. (CONF-890423—5). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004895/JAW.

From CLEO '89: conference on lasers and electro optics; Baltimore, MD, USA (24 Apr 1989).

Nonresonant multiphoton ionization of magnesium and calcium atoms has been studied using 532 nm and 1064 nm radiation in the intensity regime of 10^{10}--10^{13} W/cm^2. Intensity dependence and

angular distribution measurements are made using electron energy analysis and mass spectroscopy. The results for the two alkaline earth atoms are compared and discussed in terms of theoretical scaling laws. The importance of the role of atomic structure are also discussed. 1 ref., 1 fig.

23325 **(BNL—42374) Extraction of a steady state electron beam from HCD plasmas for EBIS applications.** Hershcovitch, A.; Kovarik, V.; Prelec, K. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 7p. (CONF-881154—5). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009522/JAW.

From International symposium on electron beam ion sources and their applications; Upton, NY, USA (14 Nov 1988).

Experiments to extract high brightness electron beams from hollow cathode discharge plasmas are now in progress. A unique feature of these plasmas, which in principle can facilitate the extraction of large current low emittance electron beams, is the existence of a relatively high energy electron population with a very narrow energy spread. This electron population was identified in a self-extraction experiment, which yielded a 35 eV, 600 mA electron beam with parallel energy spread of less than 0.5 eV. Application of a very modest extraction voltage yielded a steady state extracted electron beam current of 6.5 A of which 5.7 had a preacceleration parallel energy spread of no more than 0.25 eV. The end result of this endeavor would be an electron beam current to 6 A even though, preliminary results strongly suggest that much larger electron beam currents can be produced. 6 refs., 4 figs.

23326 **(CONF-890387—3) Polarized targets for atomic physics experiments with highly-charged ions.** Dunford, R.W.; Liu, C.J.; Mansour, N.B.; Azuma, Y.; Berry, H.G.; Church, D.A.; Dinneen, T.P.; Young, L.; Zabransky, B.J. (Argonne National Lab., IL (USA)). 1989. Contract W-31109-ENG-38. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009839/JAW.

From Workshop on highly charged ions: new physics and advanced techniques; Berkeley, CA, USA (13 Mar 1989).

We report the status of a polarized sodium beam target being developed in our laboratory. Electronic polarization is obtained by optical pumping with a single-mode ring-dye laser. Polarization close to 100% has been achieved for target thicknesses of 10^{10} atoms/cm^2. The target will be used for atomic physics experiments at the Argonne PII ECR ion source. One of the goals is to produce beams of highly-charged ions with significant electronic polarization. We also discuss plans to use a polarized hydrogen target for atomic physics experiments at the ATLAS heavy-ion accelerator. 8 refs., 6 figs.

23327 **(CONF-890424—1) Two-color studies of autoionizing states of small molecules.** Pratt, S.T.; Dehmer, P.M.; Dehmer, J.L.; Tomkins, F.S.; O'Halloran, M.A. (Argonne National Lab., IL (USA)). 1989. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89005808/JAW.

From QUELS '89: quantum electronics laser science; Baltimore, MD, USA (24 Apr 1989).

Two-color, resonantly enhanced multiphoton ionization is proving to be a valuable technique for the study of autoionizing states of small molecules. In this talk, results obtained by combining REMPI, photoelectron spectroscopy, and mass spectrometry will be discussed and will be illustrated by examples from our recent studies of rotational and vibrational autoionization in molecular hydrogen and rotational autoionization in nitric oxide. 2 refs., 1 fig.

23328 **(CONF-8811181—1) The kicked Rydberg atom: Regular and stochastic motion.** Burgdoerfer, J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007848/JAW.

From 4. international workshop on cross sections for fusion; College Station, TX, USA (2 Nov 1988).

We have investigated the dynamics of a three-dimensional classical Rydberg atom driven by a sequence of pulses. Both the deterministic system with periodic pulses and the closely related "noisy" system with random pulses have been studied in parallel. The Lyapunov exponent is calculated as a function of pulse height and the angular momentum of the initial state. We find differences between noisy and deterministic perturbations to be most pronounced for small pulse heights. Low angular momentum orbits show enhanced diffusion in agreement with recent experimental data for ion-solid interaction. 22 refs., 6 figs.

23329 **(DOE/ER/13519—3) Experimental study of interactions of highly charged ions with atoms at keV energies: Progress report for period January 16, 1988--February 20, 1989.** Kostroun, V.O. (Cornell Univ., Ithaca, NY (USA)). 1 Mar 1989. Contract FG02-86ER13519. 22p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008727/JAW.

The Cornell superconducting solenoid, cryogenic electron beam ion source CEBIS II has been rebuilt around a commercial 3 Tesla superconducting solenoid manufactured by Nicolet Instrument Corporation of Madison, WI. This solenoid has very low cryogen consumption which allows us to operate it continuously in the persistent current mode. Preliminary test with a 4.5 kV, 0.08 A electron beam show 100% transmission from cathode through the main magnetic field at 3 Tesla. The source is ready for gas and ion injection tests and experiments. An external sputter PIG ion source capable of supplying singly charged ions of elements other than noble gases has been tested, and several microampere beams of aluminum and lead ions have been produced. A Wien filter and an ion beam line with focusing optics have been designed and built and are in the process of being tested. A number of experiments utilizing our smaller, conventional solenoid EBIS, CEBIS I are in progress. These include the study of ion heating in an EBIS, a study of photon emissions from highly charged ions impinging on metal surfaces and the investigation of one and several electron capture via small angle scattering of highly charged projectiles from helium at 0.1 to 0.5 keV/amu. 2 refs., 10 figs.

23330 **(DOE/ER/45127—5) Heavy fermion and actinide materials: Scientific report for the period February 1, 1988 to January 31, 1989.** Riseborough, P.S. (Polytechnic Inst. of New York, Brooklyn (USA)). 1989. Contract FG02-84ER45127. 15p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008514/JAW.

The initial phase of this work has focused on the description of Uranium compounds and alloys that show only small or moderate mass enhancements. These types of systems have been reported as exhibiting anomalies similar to those observed in the heavy fermion systems. In these systems, the width of the Uranium f level has an appreciable contribution due to f-f overlap, in addition to the indirect overlap due to hybridization with other bands. This, together with the absence of any spectroscopic evidence for the existence of well defined specific f configurations in these metals, has motivated us to examine the properties of an N fold degenerate Hubbard model. 20 refs., 5 figs.

23331 **(FRCEA-TH—123) Collisional ionization of excited helium atoms He(n/sup 1P/) in intermediate Rydberg states by polar or high electronic affinity molecules.** Ronge, C. (Paris-11 Univ., 91 - Orsay (France)). 18 Dec 1987. 245p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88757350/JAW.

Collisional ionization of selectively excited helium atoms in the intermediate Rydberg states n/sup 1P/ (n = 14, 15, or 16) is studied in a crossed beam machine. An important He/sup +/ ion signal is detected for two types of target: (1) polar molecules (NH3, SO2, C3H60) where MJ + He(n/sup 1/p) yields M(J') + He + e/sup -/; and (2) molecules with great electronic affinity (SF6, NO2) where M + He(n/sup 1/P) yields M/sup -/ + He/sup +/. For each of these processes, the variation of the collision as a function of kinetic energy, and the absolute value of the ionization cross section in the thermal domain (200 to 500 MeV) are measured. The results cannot be interpreted with the free electron model, which reduces the interactions in the process studied to only the Rydberg electron-molecule interaction, which is treated by bipolar Born approximation. This model predicts: no ionization of Rydberg atoms near n=14 for system (1), whereas large cross sections, attributed to molecular relaxation transitions of several quanta of rotational energy are measured; and a v/sup -1//sub r/ velocity dependence

of the cross section, whereas different behavior is observed experimentally (for (1) a v/sup -2//sub r/ monotone decrease, for (2) a curve showing a maximum).

23332 **(IYaF—88-90) Nonlinear Faraday rotation in samarium vapor.** Barkov, L.M.; Melik-Pashaev, D.A.; Zolotorev, M.S. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1988. 17p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706218/JAW.

Experiments on nonlinear magnetic optical (Faraday) rotation on resonance transitions of atomic samarium are described. Measurements were carried out on transitions with different angular momenta of upper and lower states: 1->0, 0->1 and 1->1. Qualitative explanations of observed phenomena are given. 13 refs.; 8 figs.

23333 **(JAERI-M—88-228) Algebraic-eikonal approach to e-molecule collision process: two computer codes, VIBA and CROSSA, for calculation of molecular spectra and scattering cross sections.** Mengoni, A.; Shirai, Toshizo. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Nov 1988. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757264/JAW.

This report contains a description of two computer codes used for the calculation of molecular spectra and scattering cross sections for e-molecule collision process on dipolar molecules in the algebraic-eikonal approach. A brief account of the theory on which the codes are based is given in a paper on the Journal of Physics B: Atomic, Molecular and Optical Physics 21, (1988) L567. A bibliography, more extensive than the references, is included in order to provide the interested reader with a number of papers of work on this subject.

23334 **(JINR-R—4-88-91) Multichannel computation of the ground-state energies of helium-like systems within the hyperspherical coordinate method.** Abrashkevich, A.G.; Gajsak, M.I.; Lend'el, V.I.; Pojda, V.Yu.; Puzynin, I.V. (Uzhgorodskij Gosudarstvennyj Univ. (Ukrainian SSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1988. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706251/JAW.

Submitted to the journal Phys. Lett., A.

For the first time the multichannel version of the hyperspherical coordinate method is applied to compute the ground-state energies of He atom and H/sup -/, Li/sup +/, Be/sup ++/ ions. The convergence of the hyperspherical adiabatic basis is studied numerically. When solving the system of radial equations, account was taken of one to six channels; and in the expansion over bispherical harmonics use was made of the terms with orbital momenta in the range from zero to l/sub max/=3. It is shown that for determining the energies up to about 0.0001 a.u. it is necessary to solve a system of at least three radial equations. Good agreement is obtained with analogous calculations by other methods. It has been shown that the multichannel version of the hyperspherical coordinate method can be successfully used to calculate the spectra of two-electron systems. 13 refs.; 2 tabs.

23335 **(LA-UR—89-265) Monte Carlo applied to resonance scattering of high altitude fluorescent radiation.** Collins, D.; Horak, H.; Holland, R.; Sutherland, D. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 15p. (CONF-890408—8). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006519/JAW.

From Advances in nuclear engineering computation and radiation shielding; Santa Fe, NM, USA (9 Apr 1989).

Monte Carlo sampling methods developed during a recent study of resonance scattering of high altitude fluorescent radiation are discussed. The techniques employed in this study include treating the fluorescent radiation in the form of spectral lines, taking advantage of azimuthal symmetry by converting point emission data and point collision data to emission rings and collision rings to gain statistical accuracy, and using backward Monte Carlo to increase the number of samples within the field of view of highly collimated detectors. The models developed to sample spectral lines emitted by transitions within the N_2^+ first negative system are described as well the methods for propagating and scattering complete spectral lines as single entities. 6 refs., 8 figs., 1 tab.

23336 **(LA-UR—89-614) Time resolved fluorescence studies of the XeF C-A transition in avalanche discharges.** Sze, R.C.; Sakai, Tatsuhiko. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-881244—8). NTIS, PC A02 - OSTI. Order Number DE89007997/JAW.

From LASERS '88; Lake Tahoe, NV, USA (5 Dec 1988).

Time resolved fluorescence measurements have been obtained for the C-A and B-X transitions of XeF. We discuss the behavior of the fluorescence spectra in terms of fluorescence intensities with preliminary gain measurements. 4 refs., 8 figs.

23337 **(LBL—26760) Ultra-high resolution vuv-xuv laser: Application to the hyperfine study of krypton.** Kung, A.H.; Trickl, T.; Cromwell, E.; Varkking, M.J.J.; Lee, Y.T. (Lawrence Berkeley Lab., CA (USA)). Sep 1988. Contract AC03-76SF00098. 6p. (CONF-880904—9). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009059/JAW.

From 4. topical meeting on short wavelength coherent radiation: generation and applications; Cape Cod, MA, USA (26 Sep 1988).

A near-transform-limited VUV-XUV laser source with 210 MHz resolution has been constructed and used to study the hyperfine splitting, isotope shift, and lifetime of the three lowest ns (n = 5, 6, 7) Rydberg states of Krypton. 7 refs., 1 tabs.

23338 **(MLM—3578) Analysis of phase shift calculations used in second virial corrections for helium gas thermometry.** McConville, G.T. (EG and G Mound Applied Technologies, Miamisburg, OH (USA)). 15 Mar 1989. Contract AC04-88DP43495. 13p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008959/JAW.

The second virial of helium has been calculated using the new potential function of Aziz in both the LeRoy and the Taylor phase shift codes. The Taylor code uses a difference method to obtain the phase shift, whereas the LeRoy code uses the arctangent method. The arctan method appears to be preferred over the difference method because of round-off errors even in double precision calculations. There is a correction resulting from the excluded portion of the potential tail in LeRoy's code which is not in Taylor's code. The calculations show that the correction in LeRoy's code has the wrong sign at energies near the magnitude of the potential minimum. 8 refs., 3 figs., 3 tabs.

23339 **(RIAN—6) Flux distribution for particle systems with Coulomb and Newton interactions.** Sobolev, Ya.M. (AN Ukrainskoj SSR, Kharkov. Radioastronomicheskij Inst.). 1987. 31p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706272/JAW.

The distribution nulified Landau nonlinear collision integral in the case when two inertial intervals with the positive particle number flux and negative energy flux coexist is found. The distribution parametrized by the flux along the spectrum. It has power law distributions p/sup -1/, p/sup -5/2/ at small and great momentum. The validity of such asymptotics in the case of electron-ion plasma is discussed. 24 refs.; 2 figs.

23340 **(UCRL—100719) EBIT: Electron beam ion trap.** Levine, M.A.; Marrs, R.E.; Bennett, C.L.; Henderson, J.R.; Knapp, D.A.; Schneider, M.G. (Lawrence Livermore National Lab., CA (USA)). 1 Mar 1989. Contract W-7405-ENG-48. 18p. (CONF-881154—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009257/JAW.

From International symposium on electron beam ion sources and their applications; Upton, NY, USA (14 Nov 1988).

An Electron Beam Ion Trap (EBIT) has been built as an instrument for in situ studies of atomic physics. Based on the EBIS concept, EBIT incorporates several novel features including ion

cooling using light ions and plasma instability control using a short trap length. To understand the operation of EBIT, measurements have been made of the electron beam behavior. The radius of the beam is observed to follow Herrmann Theory during compression. The electron beam displays an energy dispersion that is larger than theory. However, this energy dispersion is only about 15% of the electron temperature in the trap due to the adiabatic compression of the beam. 21 refs., 7 figs.

23341 **(UCRL—100725) Atomic physics measurements in an electron Beam Ion Trap.** Marrs, R.E.; Beiersdorfer, P.; Bennett, C.; Chen, M.H.; Cowan, T.; Dietrich, D.; Henderson, J.R.; Knapp, D.A.; Osterheld, A.; Schneider, M.B. (Lawrence Livermore National Lab., CA (USA)). 1 Mar 1989. Contract W-7405-ENG-48. 14p. (CONF-881154—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009262/JAW.

From International symposium on electron beam ion sources and their applications; Upton, NY, USA (14 Nov 1988).

An electron Beam Ion Trap at Lawrence Livermore National Laboratory is being used to produce and trap very-highly-charged ions ($q \leqq 70\{+\}$) for x-ray spectroscopy measurements. Recent measurements of transition energies and electron excitation cross sections for x-ray line emission are summarized. 13 refs., 10 figs.

23342 (ZfI-Mitt—139, pp 7-14) **Effects of additional electron vacancies on parameters of the radiative excitation.** Lorenz, M. Jul 1988. (In German). NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS. Order Number DE88706276/JAW.

In 1987 scientific report of the Central Institute for Isotope and Radiation Research.

This work is aimed at demonstrating the influence which the formation of multiple-vacancy configurations has on deexcitation parameters of such a practical importance as the fluorescence yield. While in heavier systems the conception of an invariant atom core gives a good idea of K-hole filling processes the heavy-ion-induced X-ray emission from second- and third-row atoms attains a complexity which cannot even be comprehenced by a homogeneous scattering model of vacancy creation and decay. Of course, in most cases the environment was found to have a more pronounced effect on L-hole filling processes than on the corresponding K X-ray phenomena. However, apart from the enhanced complexity some other conditions exist which render its experimental detection a rather intricate task.

23343 **Photoion--photoelectron coincidence study of Kr and Xe dimers.** Norwood, K.; Luo, G.; Ng, C.Y. (Ames Laboratory, U.S. Department of Energy and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Journal of Chemical Physics;* **90**: No. 9, 4689-4696(1 May 1989).

The photoion--photoelectron coincidence (PIPECO) spectra for Kr^+_2 and Xe^+_2 in the wavelength regions of 825--970 and 900--1030 A, respectively, have been measured at different nozzle temperatures and stagnation pressures (P_0). The ionization energies (IE) for Kr_2 and Xe_2 to Kr^+_2[I(1/2)/sub u/] and Xe^+_2[I(1/2)/sub u/] determined by the PIPECO spectra are in excellent agreement with the results of previous photoionization experiments. The PIPECO measurements for Kr^+_2 and Xe^+_2 also provide lower limits for the IEs of Kr_2 and Xe_2 to Kr^+_2[II(1/2)/sub u/] and Xe^+_2[II(1/2)/sub u/]. The PIPECO spectra for Kr^+_2 and Xe^+_2 display strong autoionization structures similar to those resolved in the corresponding photoionization efficiency spectra, indicating that a significant fraction of autoionizing electrons are slow electrons with near zero kinetic energies. The extreme weakness of the Kr^+_2[II(1/2)/sub u/] and

23344 **Rotation--vibration spectra of icosahedral molecules. I. Icosahedral symmetry analysis and fine structure.** Harter, W.G.; Weeks, D.E. (Los Alamos National Laboratory T-12, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **90**: No. 9, 4727-4743(1 May 1989).

Icosahedral symmetry analysis is developed for analyzing eigensolutions of rovibrational tensor Hamiltonians for molecules such as $B_{12}H_{12}^{-2}$, $C_{20}H_{20}$, and C_{60}. Simplified asymptotic formulas and procedures are developed for obtaining rotational spectral fine structure for high angular momentum. J = 100 eigenlevels for sixth- and tenth-rank icosahedral tensors are discussed using different approximations and visualization schemes.

23345 **State-to-state dynamics of H+HX collisions. I. The H+HX→H_2+X (X = Cl,Br,I) abstraction reactions at 1.6 eV collision energy.** Aker, P.M.; Germann, G.J.; Valentini, J.J. (Department of Chemistry, University of California, Irvine, California 92717). *Journal of Chemical Physics;* **90**: No. 9, 4795-4808(1 May 1989).

The rotational and vibrational state distributions of the H_2 product from the reactions of translationally excited H atoms with HCl, HBr, and HI at 1.6 eV are probed by coherent anti-Stokes Raman scattering spectroscopy after only one collision of the fast H atom. Despite the high collision energy, only the very exoergic (ΔH = -1.4 eV) hydrogen atom abstraction involving HI leads to appreciable H_2 product vibrational excitation. For this reaction the H_2 vibrational distribution is strongly inverted and peaks in v' = 1, with 25% of the total available energy partitioned to vibration. For the mildy exoergic (ΔH = -0.72 eV) reaction with HBr and the nearly thermoneutral (ΔH = -0.05 eV) reaction with HCl, very little energy appears in H_2 vibration, 9% and 2%, respectively, and the vibrational state distributions peak at v' = 0. However, in all three reactions a significant fraction, 18% to 21%, of the total energy available appears as H_2 rotation. All three reactions show a strong propensity to conserve the translational energy, that is the translational energy of the H_2+X products is very nearly the same as that of the H+HX reactants. For the reactions with HCl, HBr, and HI the average translational energy of the products is 1.3, 1.7, and 1.7 eV, respectively, and the width of the translational energy distribution is only about 0.5 eV full width at half maximum. The energy disposal in all three reactions is quite specific, despite the fact that this high collision energy is well above the barrier to reaction in all three systems and a large number of product quantum states are energetically accessible. Only a few of these energetically allowed final states are appreciably populated.

23346 **State-to-state dynamics of H+HX collisions. II. The H+HX→HX/sup dagger/+H (X = Cl,Br,I) reactive exchange and inelastic collisions at 1.6 eV collision energy.** Aker, P.M.; Germann, G.J.; Tabor, K.D.; Valentini, J.J. (Department of Chemistry, University of California, Irvine, California 92717). *Journal of Chemical Physics;* **90**: No. 9, 4809-4818(1 May 1989).

We report measurement of product state distributions for the rotationally and/or vibrationally excited HX formed in collisions of translationally hot H atoms with HX (X = Cl, Br, and I) at 1.6 eV collision energy. The product state distributions are probed after only one collision of the fast H atom, using coherent anti-Stokes Raman scattering spectroscopy. Whether proceeding by inelastic collisions or reactive exchange, the transfer of translational energy to vibrational and rotational energy is quite inefficient in H+HX collisions at 1.6 eV. For all three hydrogen halides only 2--3% of the initial translational energy appears as HX vibration. For H+HCl only 6% of the initial energy is converted to HCl rotational energy, while for H+HBr and H+HI, this percentage is twice as large, 11--12%, but still small. The indistinguishability of the two H atoms involved makes it impossible to distinguish reactive exchange from inelastic energy transfer in these H+HX collisions. However, the difference in rotational energy partitioning for H+HBr and H+HI as compared with H+HCl, suggests that reactive exchange is dominant in the former and inelastic energy transfer dominates in the latter. The total cross sections for the combined energy transfer/reactive exchange do not change much with the identity of X, being 13 +- 3, 11 +- 2, and 11 +- 2 A^2, for H+HCl, H+HBr, and H+HI, respectively.

23347 **Low energy electron attachment to SF_6 in N_2, Ar, and Xe buffer gases.** Hunter, S.R.; Carter, J.G.; Christophorou, L.G. (Atomic, Molecular, and High Voltage Physics Group, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Chemical Physics;* **90**: No. 9, 4879-4891(1 May 1989).

The electron attachment rate constants k/sub a/ for SF_6 have been measured in dilute mixtures of SF_6 in high pressure (>1 atm) N_2, Ar, and Xe buffer gases at room temperature (T≅300 K) over a wide E/N range (electric field strength to gas number density ratio), corresponding to mean electron energies $<\epsilon>$ from near thermal electron energies (≅0.04 eV) to $<\epsilon>$≅4.3 eV. Particular attention has been paid to the effects of space charge distortion, molecular impurities, and changes in the electron energy distribution function on the measured electron attachment rate constant values at the lower E/N values in these mixtures. The present measured thermal electron attachment rate constants in SF_6/N_2 and SF_6/Xe gas mixtures are in excellent agreement with recent accurate measurements of these parameters in several SF_6/buffer gas mixtures. At higher $<\epsilon>$ values, the present SF_6/N_2 measurements are in fair agreement with previous measurements, while no previous measurements using Ar and Xe buffer gases have been published. These measurements have been used in numerical two term, spherical harmonic Boltzmann equation analyses of the electron motion in these gas mixtures to obtain the low energy (<10 eV) nondissociative and dissociative electron attachment cross sections for SF_6. The present derived electron attachment cross sections are compared with recently measured and derived nondissociative and dissociative electron attachment cross sections for SF_6.

23348 **Large computer simulations on elastic networks: Small eigenvalues and eigenvalue spectra of the Kirchhoff matrix.** Shy, L.Y.; Eichinger, B.E. (Department of Chemistry, BG-10, University of Washington, Seattle, Washington 98195). *Journal of Chemical Physics;* **90**: No. 9, 5179-5189(1 May 1989).

Computer simulations of the formation of trifunctional and tetrafunctional polydimethyl-siloxane networks that are crosslinked by condensation of telechelic chains with multifunctional crosslinking agents have been carried out on systems containing up to 1.05 x 10^6 chains. Eigenvalue spectra of Kirchhoff matrices for these networks have been evaluated at two levels of approximation: (1) inclusion of all midchain modes, and (2) suppression of midchain modes. By use of the recursion method of Haydock and Nex, we have been able to effectively diagonalize matrices with 730 498 rows and columns without actually constructing matrices of this size. The small eigenvalues have been computed by use of the Lanczos algorithm. We demonstrate the following results: (1) The smallest eigenvalues (with chain modes suppressed) vary as μ^{-2}/sup //^{3} for sufficiently large μ, where μ is the number of junctions in the network; (2) the eigenvalue spectra of the Kirchhoff matrices are well described by McKay's theory for random regular graphs in the range of the larger eigenvalues, but there are significant departures in the region of small eigenvalues where computed spectra have many more small eigenvalues than random regular graphs; (3) the smallest eigenvalues vary as n/sup -1.78/ where n is the number of Rouse beads in the chains that comprise the network. Computations are done for both monodisperse and polydisperse chain length distributions. Large eigenvalues associated with localized motion of the junctions are found as predicted by theory. The relationship between the small eigenvalues and the equilibrium modulus of elasticity is discussed, as is the relationship between viscoelasticity and the band edge of the spectrum.

23349 **Picosecond multiphoton ionization of molecular clusters.** Barton Smith, D.; Miller, J.C. (Chemical Physics Section, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6125). *Journal of Chemical Physics;* **90**: No. 9, 5203-5205(1 May 1989).

High peak-power picosecond laser pulses have been used for the first time to effect nonresonant or resonant multiphoton ionization (MPI) of clusters generated in a supersonic nozzle expansion. The resultant ions are subsequently detected and characterized by time-of-flight mass spectroscopy. Specifically, we present preliminary results involving MPI of the cluster series (NO)/sub n/ (n = 1–4), and Ar/sub n/I_2 (n = 1–10). Previous MPI studies of these two species using nanosecond lasers have not been successful, presumably due to fast dissociation channels. It is proposed that the present technique is a new and rather general ionization source for cluster studies which is complementary to electron impact but may, in addition, provide unique spectroscopic or dynamical information.

23350 **A $^2\mu^+$ state of rare gas--NO van der Waals molecules probed by 1+1 multiphoton ionization spectroscopy.** Miller, J.C. (Chemical Physics Section, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6125). *Journal of Chemical Physics;* **90**: No. 8, 4031-4036(15 Apr 1989).

The previously unobserved bound--bound spectra of ArNO, KrNO, and XeNO have been observed slightly blue shifted from the (1,0) and (0,0) bands of the A $^2\Sigma^+$ left-arrowX $^2\Pi_i$/sub //$_2$ transition of uncomplexed nitric oxide. Although the structured but incomplete spectra cannot be assigned with certainty, limits to the ground and excited state bond dissociation energies, D/sup "/$_0$ and D_0, respectively, can be estimated. For ArNO these limits are D/sup "/$_0$ ≧89 and 54 cm^{-1}≦D_0 ≦101 cm^{-1}. The observed fragmentation of the KrNO and XeNO molecules, coupled with earlier results for MPI via the C $^2\Pi$i state, suggests that superexcited, autoionizing states of the van der Waals molecules dissociate to yield excited rare gas atoms whenever energetically possible.

23351 **Radio frequency and microwave spectroscopy of the HCCH--CO_2 and DCCD--CO_2 van der Waals complexes.** Muenter, J.S. (Department of Chemistry, University of Rochester, Rochester, New York 14627). *Journal of Chemical Physics;* **90**: No. 8, 4048-4053(15 Apr 1989).

Molecular beam electric resonance spectroscopy has been used to study HCCH--CO_2 and DCCD--CO_2, giving the following results for HCCH--CO_2: A = 8875 MHz, B = 2861.45 MHz, C = 2156.25 MHz, D/sub J/ = 12.4 kHz, D/sub J//sub K/ = 36.7 kHz, and d_1 = -3.25 kHz. The permanent dipole moment is 0.1611 D. The equilibrium geometry has the monomers parallel to one another in a configuration having C_2/sub v/ symmetry. Deuterium eQq data provide information on rms vibrational amplitudes and also gives an estimate of 40 cm^{-1} for the out of plane bending mode. The monomer--monomer stretching vibration is estimated to be 75 cm^{-1} from the D/sub J/ measurement.

23352 **Theoretical study of $B_2H^+{}_4$ and B_2H_4.** Curtiss, L.A.; Pople, J.A. (Argonne National Laboratory, Chemical Technology Division/Materials Science Program, Argonne, Illinois 60439-4837). *Journal of Chemical Physics;* **90**: No. 8, 4314-4319(15 Apr 1989).

An ab initio molecular orbital study is presented of $B_2H^+{}_4$ and B_2H_4 at the G1 level of theory, including correlation energy beyond fourth-order perturbation theory and large basis sets. The $B_2H^+{}_4$ ion is predicted to have a nonplanar doubly hydrogen-bridged C_2/sub v/ structure [HB(H_2)H]. For B_2H_4, two structures of nearly equal energy are found, confirming previous work by Mohr and Lipscomb. One is a nonplanar doubly hydrogen-bridged structure similar to the cation and the other is a D_2/sub d/ H_2BBH_2 structure. The theoretical results suggest that the recently measured appearance potential for $B_2H_6 \rightarrow B_2H^+{}_4 + H_2 + e$ does not correspond to the lowest energy form of $B_2H^+{}_4$, but rather to a triply bridged isomer closely related to the most stable form of $B_2H^+{}_5$.

23353 **Use of distributed Gaussian basis sets for calculating energy levels of weakly bound complexes.** Peet, A.C. (Department of Chemistry, University of California and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Chemical Physics;* **90**: No. 8, 4363-4369(15 Apr 1989).

A basis set method for calculating the energy levels of weakly bound complexes is investigated. The basis is constructed from distributed Gaussian functions in both the bending and stretching coordinates. This produces a set of functions which are localized in the full internal space and allows the construction of nondirect product basis sets which model the known characteristics of the wave function. Low lying states which are restricted to a small portion of space may be described by functions placed just in the well region. Highly excited states usually occupy large regions of space but may still be efficiently described by modeling the regions of greatly differing wave function curvature. Application to the van der Waals complex Ar--CO_2 shows that such basis sets give a reduction of about a third in basis set size when compared with a more conventional basis of Legendre functions for the monomer ro-

tation and distributed Gaussians for the stretching motion. Such savings should increase for larger, more anisotropic systems.

23354 Upper bound for a three-photon excitation cross section in atomic argon in the ultraviolet regime. Khambatta, N.M.; Radziemski, L.J.; Dixit, S.N. (Department of Physics, New Mexico State University, Las Cruces, New Mexico 88003). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 8, 3842-3845(15 Apr 1989).

A scheme of evaluating a generalized three-photon excitation cross section σ/sub (3)/ in neutral atomic argon at 3144.67 A is outlined. Three photons at this wavelength can excite the neutral argon atoms from the ground $3p^6\ {}^1S_0$ state to the $3p^54s'[1/2]_1^0$ state. The fourth photon will ionize the argon atoms. Assuming linear polarization of the incident laser radiation, contributions from several channels in various energy-level schemes are summed in the evaluation of the transition probability. For a laser linewidth of $\Delta\lambda$/sub L/ = 1 A, our maximum numerical value of the computed result for the three-photon excitation cross section is σ/sub (3)/ = 1.414 x 10/sup -80/ $cm^6 s^2$. .AE

23355 State-selected angular distributions of single-electron capture in very slow Ar/sup 4+/-Ar collisions. Cederquist, H.; Liljeby, L.; Biedermann, C.; Levin, J.C.; O, C.; Rothard, H.; Groeneveld, K.; Vane, C.R.; Sellin, I.A. (Manne Siegbahn Institute of Physics, S-10405 Stockholm, Sweden). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 8, 4308-4311(15 Apr 1989).

The energy-gain spectra and angular distributions for single-electron capture in collisions between Ar/sup 4+/ and Ar have been measured with a new technique for six laboratory energies in the range 33--200 eV. The spectra show that the cross section is dominated by capture to the 4p state of Ar/sup 3+/, while there is no evidence of capture to the 4s state. For energies below 68 eV, forward scattering is suppressed and strong angular oscillations within the acceptance of +- 7° indicate interferences between different paths on the 4p potential curves.

23356 Improved flash γ-ray uniformity using a B/sub θ/ lens diode. Sanford, T.W.L.; Halbleib, J.A.; Poukey, J.W.; Heath, C.E.; Mock, R.; Bailey, V.L.; Proulx, G.A.; Spence, P.W.; Kishi, H. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **54**: No. 15, 1406-1408(10 Apr 1989).

Significantly improved spatial uniformity of bremsstrahlung radiation, relative to a planar-anode diode, is obtained on the 3-MV, 150-kA HELIA accelerator when a B/sub θ/ lens diode is used to actively control the high-power electron beam at the exit of a coaxial, magnetically insulated transmission line. The advantage of this diode over other diodes which only passively control the beam is that better radiation uniformity for less beam loss is possible. Measurements taken on HELIA are shown to agree with theoretical expectations.

23357 Dielectronic recombination rate coefficient for some selected ions in the helium isoelectronic sequence. Karim, K.R.; Bhalla, C.P. (Department of Physics, Cardwell Hall, Kansas State University, Manhattan, Kansas 66506). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 7, 3548-3554(1 Apr 1989).

Dielectronic recombination (DR) rate coefficients are calculated for selected heliumlike ions with atomic number Z = 10, 14, 18, 22, 24, 26, and 28 at plasma temperatures 0.1--10 keV. The total DR rate coefficient has been obtained by summing over partial DR rates of recombination processes that proceed via intermediate lithiumlike resonance states chemical bond$1s^2nl'LSJ>$. The effects of configuration interaction and spin-orbit coupling have been included for all states with $n \leqq 8$; for higher-lying autoionizing states, the $1/n^3$ scaling was employed. The results from the present calculation are compared with available theoretical and experimental values of DR rate coefficients.

23358 Highly ionized uranium emission in the soft-x-ray region 50--100 A. Finkenthal, M.; Lippmann, S.; Moos, H.W.; Mandelbaum, P.; Group, T. (Department of Physics and Astronomy, The Johns Hopkins University, Baltimore, Maryland 21218). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 7, 3717-3720(1 Apr 1989).

Time-resolved uranium spectra emitted from a relatively low-density (n/sub e/{similar←to}10/sup 13/ cm/sup -3/), high-temperature (T/sub e/{similar←to}1 keV) plasma confined in the Texas experimental tokamak (TEXT) have been recorded in the 50--100 A range. It is found that narrow emission bands originating from transitions within charge states having $5p^65d$/sup k/ and $5s^25p$/sup k/ ground configurations, U XV to U XXXI, dominate these spectra. The identification of the transition arrays is based on the comparison with both ab initio intermediate-coupling relativistic level structure computations including configuration-interaction effects for the simple cases and, for complex charge states, with the predictions of the unresolved transition array model.

23359 Lifetime of the 2^3S_1 state of heliumlike xenon (Xe/sup 52+/). Marrus, R.; Charles, P.; Indelicato, P.; de Billy, L.; Tazi, C.; Briand, J.; Simionovici, A.; Dietrich, D.D.; Bosch, F.; Liesen, D.; and others. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 7, 3725-3727(1 Apr 1989).

A precision measurement has been made of the lifetime of the 2^3S_1 state of Xe/sup 52+/ by beam-foil time-of-flight spectroscopy. The result is tau(2^3S_1) = 2.554(76) x 10/sup -12/ sec, in agreement with theortical calculations. This measurement provides the most precise test of the theory of relativistic M1 decay and is sensitive for the first time to corrections of $O(Z\alpha)^2$ to the leading term.

23360 QED contributions to the 2p-2s transitions in highly charged Li-like ions. Seely, J.F. (E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, D.C. 20375-5000). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 7, 3682-3685(1 Apr 1989).

The QED contributions to the Li-like 2p/sub 1/2/-2s/sub 1/2/ and 2p/sub 3/2/-2s/sub 1/2/ transition energies have been calculated using Grant's multiconfiguration Dirac-Fock computer package [Grant et al., Comput. Phys. Commun. 21, 207 (1980); McKenzie et al., ibid. 21, 233 (1980)]. The QED contributions were combined with the energies that were recently calculated by Johnson, Blundell, and Sapirstein [Phys. Rev. A 37, 2764 (1988)] using many-body perturbation theory. The resulting transition energies are in excellent agreement with the observed transition energies that are available for the ions with atomic numbers up to Z = 36. Transition energies are predicted for the ions up to Z = 54.

23361 Observation of transitions in lithiumlike germanium. Behring, W.E.; Seely, J.F.; Brown, C.M.; Feldman, U.; Knauer, J.P. (Solar Physics Branch, Laboratory for Astronomy and Solar Physics, NASA Goddard Space Flight Center, Greenbelt, Maryland 20771). *Journal of the Optical Society of America B: Optical Physics;* **6**: No. 4, 531-533(Apr 1989).

Transitions of the type n = 2--2, n = 2--3, and n = 3--4 in Li-like Ge/sup 29+/ have been observed in the spectrum from a laser-produced plasma. The energy levels and ionization energy of Ge/sup 29+/ were derived from the observed wavelengths. The wavelength of the $2s\ {}^2S$/sub 1/2/--$2p\ {}^2P$/sub 3/2/ transition is sufficiently accurate to determine the quantum-electrodynamic contribution to the transition energy.

23362 General and unique partitioning of molecular electronic properties into atomic contributions. Cioslowski, J. (Los Alamos National Laboratory, Theoretical Division, Group T-12, MS-J569, Los Alamos, New Mexico 87545). *Physical Review Letters;* **62**: No. 13, 1469-1471(27 Mar 1989).

We demonstrate that any first-order property can be uniquely partitioned into atomic contributions. The atomic contribution is given as a trace of the respective generalized atomic polar tensor and can be evaluated without invoking numerical integration. Parti-

tionings of the potential energy in a model one-electron problem and of the electric charge in some molecules containing lithium atoms are used to illustrate the new formalism.

23363 Dissociation of high np singlet Rydberg levels of H_2 by a pulsed electric field. Glab, W.L.; Hessler, J.P. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **62**: No. 13, 1472-1475(27 Mar 1989).

We have studied the effects of a pulsed electric field on the decay dynamics of high np, J = 1 (n>30) singlet Rydberg levels of H_2 We have discovered that pulsed fields of magnitudes much less than the classical value required for ionization induce a significant degree of dissociative character into levels which normally do not dissociate. This induced dissociation appears to occur during the slew of the field pulse and can be explained in terms of adiabatic passage through avoided curve crossings between the stable J = 1 levels and the J = 0 and 2 levels which predissociate.

23364 Finite-element method for electronic structure. White, S.R.; Wilkins, J.W.; Teter, M.P. (Laboratory of Atomic and Solid State Physics, Clark Hall, Cornell University, Ithaca, New York 14853-2501). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 9, 5819-5833(15 Mar 1989).

We discuss the use of the finite-element method in electronic-structure calculations. Products of orthogonal or nonorthogonal one-dimensional (1D) finite-element shape functions are used to form 3D basis functions on a cubic grid. The strict locality of these functions means that the matrix for any local operator is very sparse, making calculation times proportional to the number of basis functions (N) possible. The completeness of the basis can be increased globally by decreasing the grid spacing and locally by increasing the number of basis functions per site. We discuss algorithms, including the highly efficient multigrid method, for solving the Poisson equation and for the ground state of the single-particle Schroedinger equation in O(N) time. Results are presented for test calculations of H, H_2^+, He, and H_2 using as many as 500 000 basis functions.

23365 Absolute differential and integral electron excitation cross sections for atomic oxygen 7. THe $^3P \rightarrow {}^1D$ and $^3P \rightarrow {}^1S$ transitions from 4.0 to 30 eV. Doering, J.P.; Gulcicek, E.E. (Department of Chemistry, Johns Hopkins University, Baltimore, Maryland). *Journal of Geophysical Research;* **94**: No. A2, 1541-1546(1 Feb 1989).

We report the absolute differential and integral cross sections of the forbidden atomic oxygen $^3P \rightarrow {}^1D$ (1.97 eV), and $^3P \rightarrow {}^1S$ (4.19 eV), transitions for incident electron impact energies of 4.0 to 30 eV. The $^3P \rightarrow {}^1D$ cross section was measured over the entire energy range while the $^3P \rightarrow {}^1S$ transition was measured above 7 eV. The differential cross section (DCS) for the $^3P \rightarrow {}^1D$ transition is strongly backward peaked at all incident energies, in agreement with theoretical calculations. The DCS for the $^3P \rightarrow {}^1S$ transition varies considerably in shape over the energy range 7–30 eV. At the lower energies, the transition shows an axially forbidden shape (no intensity in the forward or backward direction) in agreement with the Thomas and Nesbet (1975) calculations. At higher energies (20–30 eV), the DCS has a remarkable drop near 70°. The agreement between the DCS measured here and the previous measurements of Shyn and Sharp (1986) and Shyn et al. (1986) varies from fair to poor at different incident energies. The integral cross section (ICS) for the $^3P \rightarrow {}^1D$ transition agrees within experimental error with the measurements of Shyn and Sharp (1986) and the theoretical calculations of Henry et al. (1971) at 30 eV but is larger than the previous measurements by a factor of approximately 1.3 down to 15 eV and a factor of 2 near the 5 eV peak.

23366 Method and source for producing a high concentration of positively charged molecular hydrogen or deuterium ions. Ehlers, K.W.; Leung, K.N. (to Dept. of Energy, Washington, DC). US Patent 4,793,961. 27 Dec 1988. Filed date 26 Jul 1983. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A positive ion source is described for producing a beam of high concentration positively charged molecular ions when supplied with hydrogen or deuterium, and ion source comprising: a plasma chamber constructed so as to minimize the path length of positive ions in the chamber before such ions are extracted therefrom, electron emitting means positioned in the chamber, means for metering hydrogen or deuterium into the chamber, a plasma grid, extractor electrode means located outside the chamber adjacent to an alignment with the extraction opening of the plasma grid for extracting a beam of positive ions from the chamber through the extraction opening, the electron emitting means being located closely adjacent with respect to the plasma grid and closely adjacent to the extraction opening in the plasma grid so that the path length is short in relation to the mean free path of the hydrogen or deuterium molecules in the chamber to achieve a high concentration of hydrogen or deuterium ions and to minimize the production of other ions species by collisions of the positive hydrogen or deuterium ions with hydrogen or deuterium molecules.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 22403, 22775, 23356

23367 (CONF-8807159—1) Experimental and theoretical studies of vertical annular liquid jets. Chigier, N.; Ramos, J.I.; Kihm, K. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Mechanical Engineering). 1988. Contract FG02-86ER13597. 8p. (CONF-8805106—3). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009153/JAW.

From Society for Industrial and Applied Mathematics (SIAM); Minneapolis, MN, USA (11 Jul 1988).

The stability, dynamics and convergence of vertical annular liquid jets as a function of the initial radius, sheet thickness and velocity have been studied. The influence of the Froude, Reynolds, and Weber numbers and geometry on convergence and stability are examined. Analytical and numerical techniques were used to solve the steady state and time-dependent form of the Navier-Stokes equations for inviscid curtains. Experiments were carried out on annular liquid curtains with an initial radius of 50 mm and initial sheet thicknesses of 0.5 and 1.0 mm. Three Froude numbers have been studied: 1.27, 4.27 and 8.87 by variation of the liquid flow rate. Pressure within the curtains was varied progressively from 0 to 3 Pa. Several flow regimes were found: (a) non-pressurized, (b) pressurized, (c) oscillating, and (d) punctured. Curtain shape and convergence length were determined by photography. Velocity in the liquid curtain was measured by Laser Doppler Anemometry. The variation of liquid film thickness with axial distance was determined. Good agreement was found between predictions and experiments. 6 refs.

23368 (LBL—26467) On the numerical integration of viscoelastic flow equations. Rosenberg, J.; Keunings, R. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 8p. (CONF-890479—4). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007135/JAW.

From 7. international conference on finite element methods in flow problems; Huntsville, AL, USA (3 Apr 1989).

Various numerical techniques are compared in the integration of the upper-convected Maxwell (UCM) constitutive model on the basis of known kinematics. They include Galerkin's method, streamline upwinding schemes and the method of characteristics. The results show the superiority of the latter in flows endowed with stress singularities. Solutions of the full set of momentum, mass and constitutive equations are computed with the method of characteristics and a Picard iterative scheme. Convergence difficulties are addressed. 7 refs.

23369 (WHC-EP—0194) HIVAC, a computer code for the Monte Carlo calculation of molecular flow in a high vacuum system. Schmittroth, F. (Westinghouse Hanford Co., Richland, WA (USA)). Oct 1988. Contract AC06-87RL10930. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008805/JAW.

The HIVAC code calculates the gas conductance of cylindrical vacuum systems in the molecular flow regime. It is assumed

that the mean free path is large compared to the dimensions of the vacuum system so the gas molecules interact with the vacuum conductor and not with each other. The algorithm is based on Monte Carlo methods, and transmission probabilities are first obtained by tracking a large number of molecules through the conductor as they collide with the walls. The collisional model assumes that the molecules first stick, then are re-emitted in a random direction weighted according to a cosine distribution. The conductance is obtained from the transmission probability by multiplying by the aperture conductance. Conductance values relate the gas throughput to the pressure drop across the vacuum conductor. They can therefore be used in other codes that simulate both transient and steady-state behavior of complete vacuum systems. The allowable geometries are described by a set of linked and nested cones and cylinders, an approach patterned after a similar code CHUBBY (Chubb 1966). This approach provides an easy way to model a wide variety of configurations having cylindrical symmetry. The following section describes the method and mathematical models. Next the implementation as a computer code is discussed, followed by instructions on the use of the code. The final section documents the verification and validation of the code. 5 refs., 7 figs.

23370 **On the mechanism of the reduction of nonlinearity in the incompressible Navier--Stokes equation.** Shtilman, L.; Polifke, W. (The Levich Institute of Physico-Chemical Hydrodynamics, The City College of the City University of New York, New York 10031). *Physics of Fluids A: Fluid Dynamics;* **1**: No. 5, 778-780(May 1989).

The mechanism of the reduction of nonlinearity recently observed in simulations of decaying isotropic turbulence by Kraichnan and Panda [Phys. Fluids 31, 2395 (1988)] is investigated. It is shown that although the alignment of velocity and vorticity in physical space is not the sole source of the effect, it can enhance the effect significantly. Another source of the reduction seems to be a tendency of the Lamb vector v x ω in Fourier space to align with the wave vector k. The ordering of the energy transfer is suggested to be a dynamically generic effect driving the reduction.

23371 **Rayleigh-Benard convection with time-dependent boundary conditions.** Swift, J.B.; Hohenberg, P.C. (Department of Physics and Center for Nonlinear Dynamics, University of Texas, Austin, Texas 78712). *Physical Review [Section] A: General Physics;* **39**: No. 8, 4132-4136(15 Apr 1989).

The 13-mode Lorenz model previously introduced to describe hexagons and rolls in a Rayleigh-Benard cell with periodic modulation of the lower plate is generalized to arbitrary time dependence of both upper and lower plates. Earlier results of Krishnamurti [J. Fluid Mech. 33, 445 (1968); 33, 457 (1968)] for the case of a linear ramp with constant temperature difference are recovered. The conditions for observing hexagons are derived analytically for periodic modulation with different frequencies, amplitudes, and phases at the two plates.

23372 **Detection of sulfur dimers in SF_6 and SF_6/O_2 plasma-etching discharges.** Greenberg, K.E.; Hargis P.J. Jr. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **54**: No. 14, 1374-1376(3 Apr 1989).

Sulfur dimers were detected in sulfur-hexafluoride plasma-etching discharges using optical emission spectroscopy and laser-induced fluorescence spectroscopy. Dimer densities were estimated to be on the order of $10^{13}/cm^3$ and appear to decrease rapidly with increasing oxygen content in the discharge.

23373 **Fractal measures of passively convected vector fields and scalar gradients in chaotic fluid flows.** Ott, E.; Antonsen T.M. Jr. (Laboratory for Plasma Research, Department of Electrical Engineering Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Physical Review [Section] A: General Physics;* **39**: No. 7, 3660-3671(1 Apr 1989).

The passive convection of vector fields and scalar functions by a prescribed incompressible fluid flow v(x,t) is considered for the case where v(x,t) is chaotic. By chaotic v(x,t) it is meant that typical nearby fluid elements diverge from each other exponentially in time. It is shown that in such cases, as time increases, a convected vector field and the gradient of a convected scalar will generally concentrate on a set which is fractal. The present paper relates the stretching properties of the flow to the resulting fractal dimension spectrum. Motivation for these considerations is provided by the kinematic magnetic dynamo problem (in the vector case) and (in the scalar case) by recent experiments which demonstrate the possibility of measuring the fractal dimension of the gradient squared of convected passive scalars.

23374 **Generalized Riemann problem for reactive flows.** Ben-Artzi, M. (Department of Mathematics, Technion-Israel Institute of Technology, Haifa 32000 Israel, and Department of Mechanics, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Computational Physics;* **81**: No. 1, 70-101(Mar 1989).

A generalized Riemann problem is introduced for the equations of reactive non-viscous compressible flow in one space dimension. Initial data are assumed to be linearly distributed on both sides of a jump discontinuity. The resolution of the singularity is studied and the first-order variation (in time) of flow variables is given in exact form. copyright 1989 Academic Press, Inc.

23375 **Linear analysis of the vortex-in-cell algorithm applied to Rayleigh-Taylor instability.** Zufiria, J.A. (Applied Mathematics, California Institute of Technology, Pasadena, California 91125). *Journal of Computational Physics;* **80**: No. 2, 387-402(Feb 1989).

The effect of the grid in the vortex-in-cell algorithm on the linear growth rates for an interface undergoing Rayleigh-Taylor instability is studied. Results show that the effect of the grid is qualitatively equivalent to the effect of surface tension. It is also found that only wavelengths which are ten times longer than the grid spacing are resolved with error of less than 10% in the growth rate. copyright 1989 Academic Press, Inc.

6450 High Energy Physics

REFER ALSO TO CITATION(S) 23564

23376 **(BNL—42301) Reminiscences of a particle physicist.** Goldhaber, M. (Brookhaven National Lab., Upton, NY (USA)). 31 Aug 1988. Contract AC02-76CH00016. 8p. (CONF-880862—16). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008500/JAW.

From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY, USA (29 Aug 1988).

This paper discusses some historical aspects of particle physics. (LSP)

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 22874, 22964, 23014, 23444, 23445, 23511, 23513, 23572, 23573, 23574, 23576, 23607

23377 **(BNL—42193) Strangeness {minus}2 hypernuclei.** May, M. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 15p. (CONF-8809143—6). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008179/JAW.

From Hypernuclear and low-energy kaon physics; Padova, Italy (12 Sep 1988).

Approaches to the problem of observing hypernuclei containing two lambda particles (double hypernuclei) are discussed. Existing data and its implications are examined. The relationship of double hypernuclei to other S ≦ {minus}2 systems is considered. 21 refs., 1 fig.

23378 **(BNL—42223) Production and phenomenology of glueballs.** Chan, Chang S.; Lindenbaum, S.J. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 33p. (CONF-8808198—4). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009529/JAW.

From Excited baryons; Troy, NY, USA (4 Aug 1988).

After a brief introduction, the current status of the prominent glueball candidates are reviewed. In particular, we present a partial wave analysis of 6658 events of the reaction π/sup {minus}/ p $\rightarrow$ {phi}{phi}n at 22 GeV/c. The data analysis reveals three resonances g/sub T/(2010), g/sub T'/(2300) and g/sub T{double←prime}/(2340), all with the same quantum numbers I/ sup G/J/sup PC/ = 0^+2^{++} which comprise virtually all the production cross section. The large {phi}{phi}n signal occurs over a mostly structureless and incoherent {phi}K^+K/sup {minus}/ background. The absence of the expected OZI suppression, and the striking differences of these states from conventional states and background in other channels has so far only been successfully explained by assuming they are produced by 1-3 J/sup PC/ = 2^{++} glueballs (multigluon resonances). The forthcoming search for an exotic J/sup PC/ glueball is also discussed. 20 refs., 15 figs., 1 tab.

23379 **(BNL—42235) Proton production from Si+Au collisions at 14.5 A{center←dot}GeV.** Sarabura, M.; Abbott, T.; Akiba, Y.; Alburger, D.; Beavis, D.; Betts, R.R.; Birstein, L.; Bloomer, M.A.; Bond, P.D.; Chasman, C. (Brookhaven National Lab., Upton, NY (USA); Argonne National Lab., IL (USA); Lawrence Berkeley Lab., CA (USA); Lawrence Livermore National Lab., CA (USA)). 1988. Contract AC02-76CH00016;W-31109-ENG-38;AC03-76SF00098;W-7405-ENG-48. 6p. (CONF-8809203—6). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008493/JAW.

From Quark Matter '88: 7th international conference on ultrarelativistic nucleus-nucleus collisions; Lenox, MA, USA (26 Sep 1988).

Recent results are presented from the study of central Si+Au $\rightarrow$ p+X, Si+Au $\rightarrow$ π/sup +-/+X, and Si+Cu $\rightarrow$ p+X at 14.5 A{center←dot}GeV. The distribution of protons in rapidity indicates that many target protons are found above 0.5 units. The variation of the slope parameter in rapidity is consistent with a thermal source of protons at the geometric center-of-mass rapidity. 4 refs., 4 figs.

23380 **(BNL—42241) Future opportunities for hadron spectroscopy at the MPS.** Longacre, R.S. (Brookhaven National Lab., Upton, NY (USA)). 7 Dec 1988. Contract AC02-76CH00016. 9p. (CONF-880862—15). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008492/JAW.

From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY, USA (29 Aug 1988).

Before I go into detailed MPS experiments, I will give a summary of the status of lattice gauge calculations of glueball masses plus glueball and hybrid masses from the bag model, and the flux tube model. For the following discussion, I am going to assume that multi-quark states or molecules are best described in terms of the MIT bag model of Jaffe with its spectrum best defined by work done by R.L. Jaffe and F.E. Low using a method called The P-Matrix. Using this method one sees that all 4-quark states will appear as very broad continuum like effects that one would not associate with meson resonances, except for the S* and the δ which forms a very special threshold K{bar K} bound systems. There is a possibility that the E(1420) may also be related to the J/sup PC/ = 1^{++}, qq{bar q}{bar q} spectrum having its width narrowed by a final state interaction.

23381 **(BNL—42268) Glueballs in 2^{++} {phi}{phi} final states.** Lindenbaum, S.J. (Brookhaven National Lab., Upton, NY (USA)). 19 Dec 1988. Contract AC02-76CH00016;AC02-83ER40107. 21p. (CONF-880862—18). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008491/JAW.

From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY, USA (29 Aug 1988).

In this paper we discuss the striking evidence obtained by BNL/CCNY for the g/sub T/(2010), g/sub T'/(2300) and g/sub T"/(2340) I/sup G/J/sup PC/ = 0^+2^{++} resonances which comprise virtually all of the π/sup {minus}/p $\rightarrow$ {phi}{phi}n. The complete breakdown of the expected OZI suppression, and the striking differences of these states from conventional states and background in other channels has so far only been successfully explained by assuming they are produced by 1-3 2^{++} glueballs. The comparison with J/{phi} radiative decay results is made. A discussion of other glueball candidates in the light of a coupled channel analysis of the 2^{++} and 0^{++} channels is also made. The forthcoming search for an exotic J/sup PC/ glueball is discussed. 12 refs., 10 figs., 2 tabs.

23382 **(BNL—42269) Search for a QGP with a TPC spectrometer, and QGP signals predicted by new event generator.** Lindenbaum, S.J. (Brookhaven National Lab., Upton, NY (USA)). 8 Dec 1988. Contract AC02-76CH00016;AC02-83ER40107. 21p. (CONF-8810264—8). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008496/JAW.

From Conference on hadronic matter in collision; Tucson, AZ, USA (6 Oct 1988).

The BNL/CCNY/Johns Hopkins/Rice Collaboration has developed and successfully tested a TPC Magnetic Spectrometer to search for QGP signals produced by ion beams at AGS. Test data with 14.5 GeV/c {times} A Oxygen ions incident on a Pb target has been obtained. These include a 78-prong nuclear interaction in the MPS magnet which was pattern recognized with an efficiency ~75%. A cascade and plasma event generator has also been developed, the predictions of which are used to illustrate how our technique can detect possible plasma signals at AGS and RHIC. A 4π tracking TPC magnetic spectrometer has been proposed for RHIC. The new event generator predicts striking central rapidity bump QGP signals at RHIC for p, {bar p}, π/sup +-/, K/sup +-/, etc., produced by 100 GeV/c {times} A Au on Au collisions and these are presented. 2 refs., 13 figs., 1 tab.

23383 **(BNL—42281) B factory at RHIC [Relativistic Heavy Ion Collider]?.** Lockyer, N.S.; Van Berg, R.; Newcomer, F.M.; Foley, K.; Morse, W.; Paige, F.; Polychronakos, V.; Protopopescu, S.; Rehak, P.; Sidwell, R. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 17p. (CONF-880762—5). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008497/JAW.

From Summer institute: school and workshop on relativistic heavy ion physics; Upton, NY, USA (11 Jul 1988).

A dedicated B physics experiment located in the proposed Relativistic Heavy Ion Collider at Brookhaven (RHIC) is considered. The machine may operate in a p-p mode with a luminosity in excess of 10^{32} cm/sup {minus}2/ sec/sup {minus}1/ at 250 {times} 250 GeV. The estimated B{bar B} cross section at these energies is about 10 μbarns and a run of 10^7 sec would produce roughly 10^{10} B{bar B} pairs. A comparison to similar ideas proposed for the Fermilab Tevatron Upgrade and the SSC are discussed. The most ambitious physics objective of such an experiment would be the study of CP nonconservation. Particular emphasis at this workshop was given to the self tagging mode B $\rightarrow$ $K^+\pi$/sup {minus}/. Experimental techniques developed during this experiment would be extremely useful for more ambitious projects anticipated at the SSC. 36 refs., 10 figs.

23384 **(BNL—42292) Strangeness in nuclei.** Dover, C.B. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 9p. (CONF-8811171—3). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008489/JAW.

From 17. INS international symposium on nuclear physics at intermediate energies; Tokyo, Japan (15 Nov 1988).

We review some of the motivations for the study of strange particle nuclear physics. A status report on recent progress in the spectroscopy of Λ and Σ hypernuclei is provided, as well as a discussion of future prospects for the study of S = {minus}1 and {minus}2 systems. The importance of the nuclear physics program at future high intensity hadron facilities is emphasized. 45 refs.

23385 **(BNL—42298) Precision determination of the magnetic field in a muon storage ring using the cyclotron frequency of heavy ions: A technique for use in a new measurement of the muon g-2 value.** May, M. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 10p. (CONF-881151—55). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008499/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

A new experiment will measure the muon g-2 value with 20 times better precision than it is presently known. To reach this goal, the magnetic field in the muon storage ring must be known to be a part in 10^7. This can be achieved by storing singly charged heavy ions in the ring and measuring their cyclotron frequency. 13 refs., 1 fig.

23386 **(BNL—42330) Photon scattering from the nucleon at LEGS [Laser Electron Gamma Source].** Sandorfi, A.M.; Blanpied, G.; Blecher, M.; Giordano, G.; Kistner, O.C.; Matone, G.; Preedom, B.M.; Schaerf, C.; Sealock, R.M.; Thorn, C.E. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 23p. (CONF-8808198—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008501/JAW.

From Excited baryons; Troy, NY, USA (4 Aug 1988).

The elastic scattering of linearly polarized photons is discussed as a means of measuring the E2/M1 mixing ratio in the excitation of the delta (1232) resonance. The crucial problem in extracting this quantity is the presence of interfering backgrounds. The difference of two scattering cross sections with different incident polarizations can be used to eliminate almost all of the background contributions. As a measure of the sensitivity of this method, such a cross section difference can exhibit a change of 2.4% for an E2/M1 ratio of one percent. The single correction of importance comes from the imaginary part of the fmm(1-) amplitude for magnetic dipole scattering through a spin 1/2 state. It is likely that this amplitude is strongly affected by the tail of the P11 (1470) Roper resonance, and new multipole analyses of photoproduction and Compton scattering, extending up to the energy of the P11, would help to control the errors on this term. 20 refs., 5 figs., 3 tabs.

23387 **(FNAL/C—88/156-T) Weak decay amplitudes in large N/sub c/ QCD.** Bardeen, W.A. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1988. Contract AC02-76CH03000. 24p. (CONF-8804219—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008680/JAW.

From Ringberg workshop on hadronic matrix elements and weak decays; Ringberg Castle, F.R. Germany (18 Apr 1988).

A systematic analysis of nonleptonic decay amplitudes is presented using the large N/sub c/ expansion of quantum chromodynamics. In the K-meson system, this analysis is applied to the calculation of the weak decay amplitudes, weak mixing and CP violation. 10 refs., 5 figs., 2 tabs.

23388 **(FNAL/C—88/162-T) Large transverse momentum and higher twist phenomena.** Ellis, R.K. (Fermi National Accelerator Lab., Batavia, IL (USA)). Nov 1988. Contract AC02-76CH03000. 28p. (CONF-8809224—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008692/JAW.

From Workshop on high-p{sub T} physics and higher twists; Paris, France (21 Sep 1988).

A brief summary of the physics of large transverse momentum and higher twist phenomena is given. Particle topics discussed are: higher twist effects in deep inelastic scattering; power suppressed effects at kinematic boundaries; heavy flavour production; vector boson production; and the running of the coupling constant. (LSP)

23389 **(FRNC-TH—3237) Study of the production and decay of the Λc baryon in pp interactions at 400 GeV/c.** Rafik Ouared, M. (Paris-11 Univ., 91 - Orsay (France); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie; College de France, 75 - Paris). Jun 1987. 195p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88757354/JAW.

An experiment to study the characteristics of the production and decay of the charmed particles D/sup +-/, D/sup 0/, Λc /sup +-/, and D/sup +-//sub s/ in π/sup -/p and pp interactions at 360 and 400 GeV/c is presented. It was not possible to fully attain experiment goals for Λc and D/sub s/, because of the weak statistics obtained. The various experiment steps which lead to the selection of Λc produced in pp collisions are outlined. Their average life, mass, cross sections, limits of the branching ratio in the Λc -> KP π mode were measured. Of the 553 charmed candidates selected, only 7 Λc with single signatures were retained.

23390 **(IFVE-OEF—88-153) Detection of 1.9 GeV mass exotic meson decaying into the eta'eta channel.** Alde, D.; Binon, F.; Bricman, C. and others. (Los Alamos National Lab., NM (USA); Institut Interuniversitaire des Sciences Nucleaires, Brussels (Belgium)). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706164/JAW.

Submitted to the journal Yad. Fiz. .

A meson produced in the charge-exchange π/sup -/p-collisions and decaying into eta'eta has been observed. The experiment has been carried out with the GAMS-2000 spectrometer at the Serpukhov accelerator. The meson mass equals (1917+-15) MeV, the width is (90+35)-(90-50) MeV. Its spin-parity is J/sup PC/=0/sup ++/, 1/sup -+/ or 2/sup ++/, isospin and G-parity is I/sup G/=0/sup +/. The t-dependence of the differential cross section is described by exp(bt) with small slope b=2+-1 (GeV/c)/sup 2/. For the decays through $\pi\pi$, etaeta and KK-bar channels low limits are obtained showing the exotic nature of this meson. 16 refs.; 5 figs.; 1 tab.

23391 **(IFVE-OEIUNK—88-2) Particle physics data base system at IHEP. CS data base - integral characteristics of particle collisions (description).** Alekhin, S.I.; Bazeeva, V.V.; Ezhela, V.V. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706165/JAW.

The description of data compilation on integral characteristics of particles collisions (inclusive and exclusive reaction cross sections, mean charged and partial multiplicities of hadrons produced in hadron and lepton collisions) is presented. Compilation is developed in the framework of the particle physics data bases system (PPDS) under BDMS. 7 refs.

23392 **(INFN/AE—88-6-A) Set-up and trigger for the measurement of the inclusive production of strange particles in the E704 Tevatron experiment.** Nessi Tedaldi, F.; Nessi, M.; Stanek, R.; Zanetti, A.M. (Rice Univ., Houston, TX (USA). Bonner Nuclear Labs.; Argonne National Lab., IL (USA); Istituto Nazionale di Fisica Nucleare, Trieste (Italy)). (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1988. 28p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705729/JAW.

Criteria for selecting strange particles in the interactions of polarized protons produced at the Tevatron, for measuring spin effects at high energies are illustrated.

23393 (INIS-BR—1441, pp 123-132) **Diffraction dissociation of K/sup +/ and PI/sup +/ in interactions with protons at 250 GeV/c.** Endler, A.M.F. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1986. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

Preliminary results on meson diffraction dissociation in PI/ sup +/ / K/sup +/ p interactions at 250 GeV/c are presented. Cross section is determined and the hadronization properties of meson diffraction system are studied and compared to e/sup +/ e/ sup -/ data.

23394 **(INIS-mf—11389) Measurement of asymmetries and differential cross sections in antiproton-proton elastic scattering at momenta between 497 and 1550 MeV/c.** Kunne, R.A. (Amsterdam Univ. (Netherlands)). 14 Sep 1988. 114p. NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS. Order Number DE88706087/JAW.

Includes Dutch summary.

An intermediate energy antiproton proton (anti pp) elastic scattering experiment is described. The data comprise a set of 15 measurements of the differential cross section and the asymmetry between 497 and 1550 MeV/c antiproton momentum. The measurements were carried out using the high quality antiproton beam provided by the Low Energy Antiproton Ring (LEAR) at CERN. A conventional polarized target was used, consisting of pentanol. The motivation for the measurements is the study of the anti pp interaction by providing data on the spin observable A/sub on/ in a momentum range where it has never been measured before. 56 refs.; 55 figs.; 40 tabs.

23395 **(INIS-mf—11901) Experiments at CERN in 1988.** (European Organization for Nuclear Research, Geneva (Switzerland)). Nov 1988. 289p. NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS. Order Number DE88706176/ JAW.

This book is a compilation of the current experimental programme at CERN. The experiments listed are being performed at one of the following machines: The Super Proton Synchrotron (SPS), the Proton Synchrotron (PS) and the Synchro Cyclotron (SC). The four experiments planned for the Large Electron Positron machine (LEP) are also listed. The schematic layouts of beams and experimental areas at the different machines appear at the beginning of the report. The experiments are briefly described and a schematic layout of each apparatus is included together with lists of participants and institutions. The status of the experiments (preparation/data-taking/completed) corresponds to the situation at the end of 1988. The 'completed' status means that data-taking is finished, not necessarily the analysis of the results; this status is kept for two years and then the experiment is removed from the catalogue. A complete list of all the experiments published in these books since 1974 is given at the end. (orig./HSI).

23396 (JINR—N-6-26-87, pp 4-11) **Measurement of electron mass by means of narrow component of annihilation radiation peak.** Ivanov, A.I.; Uchevatkin, I.F.; Vylov, Ts.; Gorozhankin, V.M.; Lebedev, N.A.; Pokrovskij, V.N.; Prostakov, I.A. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Metrologii, Leningrad (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01; INIS. Order Number DE89780076/JAW.

In JINR rapid communications. Collection.

Under "ice-water" phase transition the narrow component of annihilation radiation has been reliably separated with Ge(Li)-detector. This component corresponds to the thermolized para-positronium annihilation. In contrast to common approach used in invetsigations of Doppler extension of annihilation line, the /sup 22/ Na source was dissolved in annihilation volume. A narrow component peak was obtained as a difference of an ice and water annihilation spectra. The energy of narrow component peak has been measured within the energy of gamma-standards whicha have primary scale E/sub γ411.8/(/sup 198/Hg)=411.8044+-0.005 keV. Electron rest mass has been determined as m/sub 0/c/sup 2/ =511.003+-0.005 keV. The error of obtained value mainly corresponds to uncertainties of the used reference marks. The positron lifetime measurement in clear ice and in ice with dissolved source has shown that the intensities of "short" and "long" components increase in the last case from 20% upto 26% and from 1.5% upto 9%, respectively. 15 refs.; 1 fig.

23397 **(JINR-R—1-88-31) Λ(1520)-production in neutron-nuclear interactions at ~40 GeV neutron energy.** Krastev, V.R.; Aleev, A.N.; Aref'ev, V.A. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. 10p. (In Russian). NTIS (US Sales Only), PC A02/ MF A01 - OSTI; INIS. Order Number DE88706237/JAW.

Submitted to the journal Yad. Fiz. .

The data on inclusive production of the λ(1520) resonance by 40 GeV neutrons on carbon, aluminium and copper targets are presented. The experiment has been performed by means of the BIS-2 spectrometer in the neutral beam of Serpukhov accelerator. The λ(1520) was detected as a narrow peak in effective mass spectra of λ(1520)->λ/sup 0/P/sup +/P/sup -/ decay products. Kinematic region of λ(1520) registration was limited by geometry of spectrometer over transverse momentum squared P/sub T//sup 2/ arrow uparrow down0.8 GeV/sup 2//c/sup 2/, and Feynman variable x≧0.3. Within the parametrization of invariant differential cross section of inclusive production of λ(1520) (E/P/sub max/)x(d/sup 3/σ/P/sub T//sup 2/dx) ~ exp (-βrho/sub T//sup 2/)(1-x)/sup N/ or the region observed P/sup 2/ and X parameters have been found B=(3.5+-0.4)(GeV/c)/sup -2T/ and N=2.05/sub -0.3//sup +0.4/. The A dependence of this cross section can be described by a power law σ~A/sup α/ with α=0.6+-0.2. The inclusive transverse production cross section of λ(1520) over the kinematic reon 0<x<1 is 70.6+-5.8 (stat)+-15.5 per nucleon. 17 refs.; 9 figs.; 2 tabs.

23398 (KEK—88-6, pp 21-40) **Search for quark gluon plasma at the CERN SPS.** En'yo, H. (CERN, Geneva (Switzerland)). Sep 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE89780072/JAW. (CONF-8802137—).

From Workshop on physics of quark-gluon-plasma; Tsukuba, Japan (18 Feb 1988).

The experimental results from 200 GeV/N and 60 GeV/N oxygen nucleus interactions measured in the CERN SPS experiment are reviewed. I discuss these results attempting to figure out how close we are to the detection of a phase transition of nuclear matter.

23399 (KEK-PR—88-1, pp 163-180) **Experimental study of the atmospheric neutrino flux.** Hirata, K.S.; Kajita, T.; Koshiba, M. and others. (Tokyo Univ. (Japan). Faculty of Science). 1988. NTIS (US Sales Only), PC A20/MF A01. Order Number DE89780073/JAW. (CONF-8802136—).

From 2. workshop on elementary-particle picture of the universe; Tsukuba, Japan (4 Feb 1988).

We have observed 277 fully contained events in the KAMIOKANDE detector. The number of electron-like single prong events is in good agreement with the predictions of a Monte Carlo calculation based on atmospheric neutrino interactions in the detector. On the other hand, the number of muon-like single prong events is 59 +- 7 %(statistical error) of the predicted number of the Monte Carlo calculation. We are unable to explain the data as the result of systematic detector effects or uncertainties in the atmospheric neutrino fluxes.

23400 **(LA-UR—89-642) Measurements of the electron-antineutrino mass.** Wilkerson, J.F. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 17p. (CONF-8810327—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008001/JAW.

From Breaking of fundamental symmetries in nuclei workshop; Santa Fe, NM, USA (12 Oct 1988).

Although it has been over 50 years since the neutrino was postulated by Pauli and nearly 35 years since the first experimental evidence of neutrinos was observed by Reines and Cowan, the question of whether the neutrino has a non-zero mass still remains unanswered. Today, more than a dozen experiments observing the beta-decay of tritium are underway in the quest for an answer to this question. By making sensitive measurements of the beta decay spectrum about the endpoint these experiments allow for the direct kinematic determination of the electron-antineutrino mass. However, extraction of the neutrino mass from the observed data requires accurate accounting of experimental systematic effects that modify the beta spectrum. The techniques required to make accurate deter-

mination of the electron-antineutrino mass as well as the results from and status of ongoing tritium beta decay experiments are presented. 40 refs., 2 figs.

23401 **(LAL—8846) CP Violation in K-Decays.** Fournier, D. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire; Paris-11 Univ., 91 - Orsay (France)). Sep 1988. 39p. (CONF-8805273—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757211/JAW.

From 15. international meeting on fundamental physics; Peniscola, Spain (1 May 1988).

The phenomenology of K decays, and particularly CP violation, was investigated in Fermilab and CERN NA31 experiments. Other CP related measurements in the neutral kaon system were also made. Observation of direct CP violation in K ->2π is significant in the study of weak decays and in the understanding of CP violation. It rules out the super weak model and is in qualitative agreement with expectations based on the standard model of electroweak interactions.

23402 **(LBL—26415) Vector-vector production in photon-photon interactions.** Ronan, M.T. (Lawrence Berkeley Lab., CA (USA)). 9 Dec 1988. Contract AC03-76SF00098. 9p. (CONF-880862—17). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008171/JAW.

From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY, USA (29 Aug 1988).

Measurements of exclusive untagged {rho}^{0}{rho}^{0}, {rho}{phi}, K/sup */{bar K}/sup */, and {rho}ω production and tagged {rho}^{0}{rho}^{0} production in photon-photon interactions by the TPC/Two-Gamma experiment are reviewed. Comparisons to the results of other experiments and to models of vector-vector production are made. Fits to the data following a four quark model prescription for vector meson pair production are also presented. 10 refs., 9 figs.

23403 **(LBL—26448) New particle signals at the SSC and at an upgraded Tevatron collider.** Barnett, R.M.; Hollebeek, R.J.; White, A.P.; Yoh, J.; Baer, H.A.; Barnett, B.A.; Eichten, E.; Freeman, J.E.; Gamberini, G.; Grifols, J.A. (Lawrence Berkeley Lab., CA (USA)). 1988. Contract AC03-76SF00098. 25p. (CONF-8806243—34). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008173/JAW.

From DPF summer study: Snowmass '88 on high energy physics in the 1990s; Snowmass, CO, USA (27 Jun 1988).

We have studied the production and detection of several types of new particles at the Superconducting Super Collider (SSC) and at three possible upgrades of the Fermilab Tevatron Collider. We compare the physics potential of the SSC with that of an upgraded collider, and we discuss in depth the relative capabilities of the three Tevatron Collider upgrades. From a physics standpoint, we suggest that one of the proposed upgrades has several advantages. 34 refs., 21 figs., 5 tabs.

23404 **(LBL—26590) A measurement of strangeness production in 200 GeV/C/A ^{32}S and ^{1}p-nucleus interactions using the NA36 TPC.** Greiner, D.; Anderssen, E.; Barnes, P.D.; Blaes, R.; Braun, H.; Brom, J.; Castano, B.; Cherney, M.; Cohler, M.; Diebold, G.E. (Lawrence Berkeley Lab., CA (USA)). Jan 1989. Contract AC03-76SF00098. 10p. (CONF-8810264—7). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008150/JAW.

From Conference on hadronic matter in collision; Tucson, AZ, USA (6 Oct 1988).

Results from the NA36 experiment obtained with the ^{32}S beam at the CERN SPS during the 1987 run are presented. Production of lambda particles by proton and ^{32}S beams was studied. 8 figs.

23405 **(SLAC—338) Resonance production in two-photon interactions.** Roe, N.A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1989. Contract AC03-76SF00515. 116p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009006/JAW.

Resonance production in two-photon interactions is studied using data collected with the ASP detector at the PEP e$^+$e/sup {minus}/ storage ring located at the Stanford Linear Accelerator Center. The ASP detector is a non-magnetic lead-glass calorimeter constructed from 632 lead-glass bars. It covers 94% of 4π in solid angle, extending to within 20{degree} of the beamline. Lead-scintillator calorimeters extend the coverage to within 21 mr of the beamline on both sides. Energy resolution of $\sqrt{E}$/10%, where E is the energy is GeV, is achieved for electrons and photons in the lead-glass calorimeter, and particle trajectories are reconstructed with high efficiency. A total luminosity of 108 pb/sup {minus}1/ was collected with the ASP detector at a center-of-mass energy of 29 GeV. The observed process is e$^+$e/sup {minus}/ $\rightarrow$ e$^+$e/sup {minus}/$\gamma^*\gamma^* \rightarrow$ e$^+$e/sup {minus}/X, is a pseudoscalar resonance (J/sup PC/ = 0/sup {minus}+/) and γ^* is a virtual (mass {ne} 0) photon. The outgoing electrons scatter down the beampipe and are not detected. The observed resonances are the {eta} and {eta}' mesons, with masses of 549 and 958 MeV, respectively. They are detected in the $\gamma\gamma$ decay mode; a total of 2380 +- 49 {eta} $\rightarrow \gamma\gamma$ and 568 +- 26 {eta}' $\rightarrow \gamma\gamma$ events are observed. From the number of events, the detection efficiency, and the calculated production cross sections the radiative widths, Γ/sub $\gamma\gamma$/, of the {eta} and {eta}' were measured and found to be: Γ/sub $\gamma\gamma$/({eta}) = .481 +- .010 +- .047keV and Γ/sub $\gamma\gamma$/({eta}') = 4.71 +- .22 +- .70keV. These results are in good agreement with the world average values. 67 refs., 42 figs., 20 tabs.

23406 **(SLAC-PUB—4826) Evidence for D/sub s/$^+$ $\rightarrow$ e$^+$X.** Pitman, D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1989. Contract AC03-76SF00515. 8p. (CONF-880747—5). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008940/JAW.

From 16. annual SLAC summer institute on particles physics; Stanford, CA, USA (18 Jul 1988).

We have searched for the inclusive reaction D/sub s/$^{+-}$ $\rightarrow$ e^{+-}X using a tagged sample of 73 D/sub s/$^{+-}$ produced in the reaction e$^+$e/sup {minus}/ $\rightarrow$ D/sub s/$^{+-}$D/sub s//sup */$^{-+}$. The data were collected by the Mark III experiment at SPEAR at a center-of-mass energy of 4.14 GeV. The tagged sample consists of the decays D/sub s/$^+$ $\rightarrow$ {phi}π^+, D/sub s/$^+$ $\rightarrow$ {bar K}{bar {asterisk}}^{0}K$^+$ and D/sub s/$^+$ $\rightarrow$ K/sub s/^{0}K$^+$. We determine B(D/sub s/$^+$ $\rightarrow$ e$^+$X) = 0.09/sub {minus}0.07//sup +0.09/ {+-} 0.02. 9 refs., 6 figs., 2 tabs.

23407 **(SLAC-PUB—4828) Results from MARK III on the J/{psi} decays.** Mallik, U. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1989. Contract AC03-76SF00515. 12p. (CONF-880862—19). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008943/JAW.

From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY, USA (29 Aug 1988).

The MARK III detector at the SPEAR e$^+$e/sup {minus}/ storage ring at SLAC accumulated a data sample of 5.8 {times} 10^6 J/{psi} produced in 1982, '83 and '85. Recent results in radiative decays, including different decay modes of the {eta}/sub c/ and the search for scalars, are presented. The systematic study of the hadronic decays of the J/{psi} into a vector-tensor meson pair is discussed, and a detailed analysis of the decay mode J/{psi} $\rightarrow \omega f_2(1270)$ is described. 12 refs., 12 figs., 1 tab.

23408 **(SLAC-PUB—4838) Report of the B-factory Group: 1, Physics and techniques.** Feldman, G.J.; Cassel, D.G.; Siemann, R.H.; Alam, M.S.; Aleksan, R.; Atwood, W.B.; Bartelt, J.; Bisognano, J.J.; Boyce, J.R.; Cline, D.B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1989. Contract AC03-76SF00515. 11p. (CLNS—89/884; LBL—26790; CONF-8806243—35). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008987/JAW.

From DPF summer study: Snowmass '88 on high energy physics in the 1990s; Snowmass, CO, USA (27 Jun 1988).

The study of B meson decay appears to offer a unique opportunity to measure basic parameters of the Standard Model, probe for interactions mediated by higher mass particles, and inves-

tigate the origin of CP violation. These opportunities have been enhanced by the results of two measurements. The first is the measurement of a long B meson lifetime. In addition to allowing a simpler identification of B mesons and a measurement of the time of their decay, this observation implies that normal decays are suppressed, making rare decays more prevalent. The second measurement is that neutral B mesons are strongly mixed. This enhances the possibilities for studying CP violation in the B system. The CESR storage ring is likely to dominate the study of B physics in e+ e/sup {minus}/ annihilations for about the next five years. First, CESR has already reached a luminosity of 10^{32} cm/sup {minus}1/ sec/sup {minus}1/ and has plans for improvements which may increase the luminosity by a factor of about five. Second, a second-generation detector, CLEO II, will start running in 1989. Given this background, the main focus of this working group was to ask what is needed for the mid- to late-1990 s. Many laboratories are thinking about new facilities involving a variety of techniques. To help clarify the choices, we focused on one example of CP violation and estimated the luminosity required to measure it using different techniques. We will briefly describe the requirements for detectors matched to these techniques. In particular, we will give a conceptual design of a possible detector for asymmetric collisions at the Y(4S) resonance, one of the attractive techniques which will emerge from this study. A discussion of accelerator technology issues for using these techniques forms the second half of the B-factory Group report, and it follows in these proceedings. 34 refs., 2 figs., 2 tabs.

23409 **(SLAC-PUB—4839) Report of the B-factory group: II, Accelerator technology.** Siemann, R.H.; Cassel, D.G.; Feldman, G.J.; Alam, M.S.; Aleksan, R.; Atwood, W.B.; Bartelt, J.; Bisognano, J.J.; Boyce, J.R.; Cline, D.B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1989. Contract AC03-76SF00515. 15p. (CLNS—89/883; LBL—26791; CONF-8806243—36). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008945/JAW.

From DPF summer study: Snowmass '88 on high energy physics in the 1990s; Snowmass, CO, USA (27 Jun 1988).

This report discusses the following topics on B-factory accelerators: Storage rings for the Y(4S) and continuing Linear colliders for the Y(4S) and continuum; and storage rings and linear colliders for the Z. 52 refs., 5 figs., 12 tabs.

23410 **(SLAC-PUB—4844) New particle searches in e+ e/sup {minus}/ collisions.** Baltay, C.; Burke, D.; Schindler, R.; Chen, M.; Kane, G.; Nauenberg, U. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1989. Contract AC03-76SF00515. 13p. (CONF-8806243—37). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008941/JAW.

From DPF summer study: Snowmass '88 on high energy physics in the 1990s; Snowmass, CO, USA (27 Jun 1988).

This report summarizes the results of the Study Group on New Particle Searches at e+ e/sup {minus}/ Colliders. The work of this Group was organized by U. Nauenberg. The Group was divided into two subgroups: Low Energy Colliders (E/sub cm/ ≦ 200 GeV) led by R. Schindler and M. Chen, and High Energy Colliders (E/sub cm/ ≧ 200 GeV) led by D. Burke. A variety of e+ e/sup {minus}/ colliders, from 100 GeV to 2 TeV in the center-of-mass, were considered. Some of these facilities (SLC and LEP) are now under construction and will start opening in the next year or so, while the high energy colliders are quite hypothetical with no credible designs existing at this time. 3 refs., 20 figs., 6 tabs.

23411 **Spin-parameter measurements in inclusive Σ0 production.** Bonner, B.E.; Buchanan, J.A.; Clement, J.M.; Corcoran, M.D.; Krishna, N.M.; Kruk, J.W.; Lincoln, D.W.; Miettinen, H.E.; Mutchler, G.S.; Nessi-Tedaldi, F.; and others. (T. W. Bonner Laboratories, Physics Department, Rice University, Houston, Texas 77251). *Physical Review Letters;* **62**: No. 14, 1591-1594(3 Apr 1989).

We have measured the polarization P, the analyzing power A, and the polarization transfer D of Σ0's produced inclusively by a polarized proton beam at 18.5 GeV/c. Our data cover a region of moderate p/sub T/ (average 1 GeV/c) and Feynman x up to 0.75. We find agreement with a previous measurement of the Σ0 polarization P. We observe nonzero values for A and D, but they are significantly smaller than predictions based on a simple parton-recombination model. We have extended this model to include finite transversity spin flips, which improves agreement with the data considerably.

23412 **Study of the semileptonic decay mode D0→K− e+ ν /sub e/.** Anjos, J.C.; Appel, J.A.; Bean, A.; Bracker, S.B.; Browder, T.E.; Cremaldi, L.M.; Duboscq, J.E.; Elliott, J.R.; Escobar, C.O.; Estabrooks, P.; and others. (University of California, Santa Bargara, California 93106). *Physical Review Letters;* **62**: No. 14, 1587-1590(3 Apr 1989).

We present an analysis of the exclusive semileptonic decay mode D0→K− e+ ν/sub e/. We have measured the ratio of decay rates .11(syst), which corresponds to a D0→K− e+ ν/sub e/ branching fraction of (3.8 +- 0.5 +- 0.6)%. Combining our result with a measurement of the D0 lifetime, we find (.1 +- 1.4) x 10/sup 10/ s/sup -1/. We have also measured the vector form factor f/sub +/(t) and find that it is consistent with the single-pole form where the pole mass M/sub D//sub >//sub s//sup *//sup =/ = 2.11 GeV/c^2.

23413 **Limits on new-lepton pairs (L−,L0) with arbitrary neutrino mass.** Stoker, D.P.; Perl, M.L.; Abrams, G.; Baden, A.R.; Barklow, T.; Barnett, B.A.; Boyarski, A.M.; Boyer, J.; Burchat, P.R.; Butler, F.; and others. (Johns Hopkins University, Baltimore, Maryland 21218 Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309 Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 7, 1811-1824(1 Apr 1989).

We have searched 205 pb/sup -1/ of $\sqrt{s}$ = 29 GeV data from the Mark II detector at the SLAC e+ e− storage ring PEP for events which may signify the existence of a new lepton pair (L−,L0) where the L0 may be massive, but does not exceed the L− mass. Three event signatures for L+ L− decay are examined: (i) e/sup +- /μ/sup minus-or-plus/, (ii) (e or μ)/sup +- /(π/sup minus-or-plus/+≦4γ), and (iii) (e or μ)/sup +- /(≧3π/sup +- / +≧0γ)/sup minus-or-plus/. The numbers of signature events are found to be in good agreement with Monte Carlo simulations of known background sources. The ranges of L− and L0 masses for which new lepton pairs are excluded are obtained using a likelihood-ratio method to compare the number of observed signature events to the expected background, and to the expected background plus Monte Carlo predictions of (L−,L0) signals.

23414 **Measurement of single and double radiative low-Q^2 Bhabha scattering at E/sub c.m./ = 29 GeV.** Karlen, D.; Abrams, G.; Amidei, D.; Baden, A.R.; Barklow, T.; Boyarski, A.M.; Boyer, J.; Burchat, P.R.; Burke, D.L.; Butler, F.; and others. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305 Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720 Department of Physics, Harvard University, Cambridge, Massachusetts 02138). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 7, 1861-1864(1 Apr 1989).

The process e+ e−→e+ e− γ(γ), where one electron scatters at a small angle, is studied with data from the Mark II detector at the SLAC storage ring PEP. The data are in excellent agreement with a Monte Carlo calculation and include a large contribution from order α^4. The ratio of measured to calculated cross sections is R = 0.993 +- 0.017 +- 0.015, where the first error is statistical and the second systematic. This is a sensitive test of the calculation of the dominant background for neutrino-counting experiments.

23415 **Diffractive production of πp π− π+ in 200-GeV/c π− N interactions.** Joyner, R.W.; Chang, C.C.; Davis, T.C.; Diamond, R.N.; Johnson, K.J.; Mikocki, S.; Poirier, J.A.; Chen, T.Y.; Jenkins, E.W.; Lai, K.W.; and others. (University of Notre Dame, Notre Dame, Indiana 46556). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 7, 1865-1869(1 Apr 1989).

This paper analyzes $\pi^- N \to \pi^- \pi^- \pi^+ N$ events from Fermilab experiment E-580, using 200-GeV/c particles on a segmented target of plastic scintillator. Starting with 48 657 triggers, data-quality cuts and a cut on missing mass squared of $M^2 < 16$ GeV^2 lead to a final sample of 7205 events. The x/sub F/ distribution of the 3π system shows almost all events in a sharp peak at x/sub F/ = 1, suggesting the presence of beam diffraction into three pions. The overall t' distribution is fit to the sum of three exponential terms corresponding to coherent diffraction from carbon nuclei, diffraction from individual nucleons, and background. Cross sections per nucleon and exponential slopes are reported for each of the three components as a function of 3π effective mass. The cross section for diffraction from the nucleons in the target is 0.34 +- 0.04 mb/nucleon. The cross section for coherent diffraction from carbon is 1.08 +- 0.12 mb/nucleus. The exponential slope for diffraction is observed to decrease with increasing 3π effective mass. The fraction of coherent carbon diffraction in the total cross section is observed to decrease with increasing 3π effective mass. In the $\pi^- \pi^+$ effective-mass spectrum the rho^0(770) and f^0(1270) are observed and their cross sections per nucleon are calculated. In the $\pi^- \pi^- \pi^+$ effective-mass spectrum the A_1^-/A_2^- and A_3^- enhancements are observed and a cross section for the A_3^- is calculated.

23416 Experimental study of upward-going muons in Kamiokande. Oyama, Y.; Hirata, K.S.; Kajita, T.; Kifune, T.; Kihara, K.; Nakahata, M.; Nakamura, K.; Ohara, S.; Sato, N.; Takita, M.; and others. (Institute for Cosmic Ray Research, University of Tokyo, Tokyo 188, Japan). *Physical Review [Section] D: Particles and Fields;* **39**: No. 6, 1481-1491(15 Mar 1989).

Upward-going muons produced in the surrounding rock by high-energy neutrinos from astronomical objects have been searched for using the large underground water Cherenkov detector, Kamiokande. During a total of 1255 days observation, no significant signal was observed from the direction of eight astronomical objects. The 90%-confidence-level (-C.L.) upper limits on upward-going muon fluxes with energy greater than 1.7 GeV are 9.9 x 10/sup -14/ cm/sup -2/s/sup -1/ for Cygnus X-3 and 2.6 x 10/sup -14/ cm/sup -2/s/sup -1/ for LMC X-4. Our observed upward-going muon flux is compared with the calculation of the upward-going muon flux produced by the atmospheric neutrinos to examine the neutrino-oscillation hypothesis. The experimental average upward-going muon flux with energy greater than 1.7 GeV, (2.05 +- 0.18) x 10/sup -13/ cm/sup -2/s/sup -1/sr/sup -1/, is consistent with the theoretical expectation. If ν/sub μ/left-right-arrowν/sub tau/ vacuum oscillations and large mixing angle are assumed, Δm^2approx. >10/sup -2/ eV^2 is newly rejected. The 90%-C.L. upper limit on the Δm^2 for the maximum mixing is found to be $\Delta m^2 = 0.03$ eV^2 and $\Delta m^2 = 0.0055$ eV^2, depending on assumptions.

23417 Precision measurement of R = σ/sub L//σ/sub T/ and F_2 in deep inelastic electron scattering on deuterium and iron targets. Bosted, P.; Dasu, S.; Walker, R.C.; Whitlow, L.W.; Alster, J.; Arnold, R.; de Barbaro, P.; Benton, D.; Bodek, A.; Button-Shafer, J.; and others. (The American University, Washington, DC 20016). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 508-514(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We report new results on a precision measurement of the ratio R = σ/sub L//σ/sub T/ from deuterium, iron and gold targets, on the ratio σ/sup F//sup e//σ/sup D/ and on the structure function F_2, for deep inelastic electron-nucleus scattering in the range $0.2 \leqq x \leqq 0.5$ and $1 \leqq Q^2 \leqq 10$(GeV/c)^2. We find no difference between R/sup F//sup e/ and R/sup d/. Our results show, for first time, a clear falloff of R with increasing Q^2 at SLAC energies. Our R and F_2 results are in good agreement with QCD predictions only when corrections for target mass effects are included.

23418 Search for QGP signals at AGS with a TPC spectrometer, and comparison of our event generator predictions for plasma model and cascade interactions. Lindenbaum, S.J.; Foley, K.J.; Eiseman, S.E.; Etkin, A.; Hackenburg, R.W.; Longacre, R.S.; Love, W.A.; Morris, T.W.; Platner, E.D.; Saulys, A.C.; and others. (Brookhaven National Laboratory and City College of New York). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 778-786(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We have developed and successfully tested a TPC Magnetic Spectrometer to search for QGP signals produced by ion beams at AGS. We also developed a cascade and plasma event generator the predictions of which are used to illustrate how our technique can detect possible plasma signals.

23419 Glueballs and hadron spectroscopy. Meshkov, S. (California Institute of Technology, Pasadena, CA 91125 National Bureau of Standards, Gaithersburg, MD 20899). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 796-804(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Identifying glueballs is intimately intertwined with the study of meson spectroscopy. In this brief review, recent experimental results are compared with QCD inspired predictions for the masses of the 0^{-+}, 1^{+-}, 1^{--}, 1^{++} mesons. They agree remarkably well. For the 0^{-+} and 1^{++} systems, these agreements lead to the possibility of identifying additional states as candidates for exotica. A major mystery is why the 2^{++} g/sub T/ states are not seen in J/psi→yphiphi, in view of the fact that the OZI-violating mechanism should be a good way to produce glueballs.

23420 Spin parameters in inclusive hyperon production. Nessi-Tedaldi, F. (T. W. Bonner Nuclear Laboratories, Rice University, Houston, Texas 77251-1892). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1180-1184(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The present status of polarization parameter measurements is briefly summarized. First results for analyzing power A and polarization transfer D in inclusive Σ^0 production are presented, as well as new results for Λ, K^0/sub S/ and Λ inclusive production.

23421 Electron-positron collision physics: 1 MeV to 2 TeV. Perl, M.L. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1185-1205(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

An overview of electron-positron collision physics is presented. It begins at 1 MeV, the energy region of positronium formation, and extends to 2 TeV, the energy region which requires an electron-positron linear collider. In addition, the concept of searching for a lepton-specific force is discussed.

23422 Glueball candidates in radiative J/psi decays. Wisniewski, W.J. (California Institute of Technology, Pasadena, CA 91125). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 787-795(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The Mark III Collaboration has acquired a data set of 5.8 x 10^6 J/psi. The data were taken using the Mark III detector, a general purpose solenoidal detector installed at the e^+e^- storage ring SPEAR. A search for glueball candidates from radiative decays of the J/psi is presented. (AIP)

23423 New precision experiment to measure the muon g-2 value. May, M. (Brookhaven National Laboratory, Upton, New York, 11973). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1168-1173(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

A new measurement[1] of the g-2 value of the muon with a sensitivity of .35 parts per million is being prepared at the Brookhaven National Laboratory Alternate Gradient Synchrotron (BNL AGS). The weak interaction contributes significantly to the magnetic moment anomaly at the planned level sensitivity.

23424 Status of E811: Hyperon weak radiative decay. Noble, A.J.; Hasinoff, M.D.; Measday, D.F.; Waltham, C.E.; Hessey, N.P.; Lowe, J.; Booth, E.C.; Gall, K.P.; McIntyre, E.K.; Miller, J.P.; and others. (University of British Columbia, Vancouver, B.C., Canada V6T 2A6). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 842-843(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We report the status of branching ratio measurements of $\Sigma^+ \rightarrow p+\gamma$ and $\Lambda \rightarrow n+\gamma$. For the Σ^+ decay a preliminary result is presented.

23425 MEGA experiment: A search for $\mu \rightarrow e\gamma$. Cooper, M.D. (Los Alamos National Laboratory, Los Alamos, NM 87545, USA). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 845-849(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The MEGA experiment is designed to search for the $\mu \rightarrow e\gamma$ process with a branching ratio sensitivity of 10^{-13}. This decay violates the empirically established rule of lepton family number conservation and lies outside the Standard Model of electroweak interactions. In order for the experiment to make a factor of 500 improvement over the existing limit, a new design was adopted that employs highly modular, fast detectors and state-of-the-art electronic readout. The detectors are contained in a 15 kG solenoidal field produced by a superconducting magnet. The central region is a positron spectrometer, and the outer region is four layers of pair spectrometers. Data taking is expected to commence in 1989.

23426 Status of a study of the decay $K^+ \rightarrow \pi^+ \nu$nu-bar. Strand, R.C. (Brookhaven, Princeton, TRIUMF). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 866-873(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

AGS-787, BNL-Princeton-TRIUMF, began taking data in February 1988 on rare K^+ decays into π^+ and non-interacting neutrals. Recent observations of B-B-bar mixing have sharpened the branching ratio prediction of the three generation standard model, (SM), to {similar←to}1–5 x 10^{-10} for $\pi^+ \nu$nu-bar. The detector has 2π acceptance for this decay and 4π acceptance for background gammas. A very large window for viewing new physics exists between the SM value and the previous experimental limit of 1.4 x 10^{-7}. Several other predicted rare K^+ decays can be detected. The performance of the detector is described.

23427 In search of $K^+ \rightarrow \pi^+ \mu^+ e^-$ and other particles seldom or never before seen. Lazarus, D.M.; Gordon, H.A.; Rehak, P.; Cooper, P.S.; Egger, J.; Herold, W.D.; Kaspar, H.; Chaloupka, V.; Jagel, E.A.; Lubatti, H.J.; and others. (Brookhaven National Laboratory). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 874-881(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The progress of AGS Experiment 777, a search for $K^+ \rightarrow \pi^+ \mu^+ e^-$ is described. Results on the decay $K^+ \rightarrow \pi^+ A^0$, where A^0 is a weakly interacting neutral particle that decays into $e^+ e^-$ and preliminary results on the direct decay $K^+ \rightarrow \pi^+ e^+ e^-$ are presented as well as new limits on $\pi^0 \rightarrow \mu^+ e^-$.

23428 New results on weak decays of charmed mesons. Sliwa, K. (Fermilab). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 882-889(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Results of a study of the exclusive semileptonic decay modes $D^0 \rightarrow K^- e^+ \nu$/sub e/ and $D^+ \rightarrow K^- \pi^+ e^+ \nu$/sub e/ are presented. We have measured their branching fractions relative to those of dominant hadronic modes, BF($D^0 \rightarrow K^- e^+ \nu$/sub e/)/BF($D^0 \rightarrow K^- \pi^+$) = 0.91 +- 0.07 +- 0.11 and BF($D^+ \rightarrow K^* e^+ \nu$/sub e/)/BF($D^+ \rightarrow K^- \pi^+ \pi^+$) = 0.53 +- 0.05 +- 0.06. The non-resonant $K\pi$ component in the $D^+ \rightarrow K\pi e\nu$ decay mode was found to be small. Combining our results with measurements with the D^0 lifetime and a branching fraction for the mode $D^0 \rightarrow K^- \pi^+$ we find {vert←bar}V/sub c//sub s/{vert←bar}^{2}equivalentf/sub +/(0){vert←bar}^{2} = 0.50 +- 0.07 +- 0.08. We have observed signals for decays D^+/sub s/ and $D^+ \rightarrow \pi^- \pi^+ \pi^+$. We have analysed these modes for the fraction due to rho$^0 \pi^+$ and $f_0(975)\pi^+$ and measured their relative branching fractions. Also, we present limits on flavour-changing neutral current decays $D^0 \rightarrow e^+ e^-$ and $D^0 \rightarrow \mu e$.

23429 Search for neutrino oscillations at LAMPF. Durkin, L.S.; Harper, R.; Ling, T.Y.; Mitchell, J.; Romanowski, T.A.; Smith, E.; Timko, M.; Freedman, S.; Napolitano, J.; Choi, C.; and others. (The Ohio State University, Columbus, Ohio). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 953-956(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

This experiment searches for the appearance of anti- ν/sub e/ resulting from the oscillation mode anti-ν/sub μ/→anti-ν/sub e/. The experiment was carried out at the Los Alamos Meson Physics Facility (LAMPF). (AIP)

23430 BNL E776: A search for neutrino oscillations. Seto, R. (Columbia University, New York, NY 10027). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 957-963(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We report on the results of BNL E776, carried out at the Brookhaven National Laboratory in the summer and fall of 1986. Its purpose was to search for neutrino oscillations, through the appearance of ν/sub e/ in a ν/sub μ/ beam. The experiment used a low energy narrow band beam of ν/sub μ/ with a mean energy of about 1.4 GeV, and a detector at a distance of 1 km from the target. With 3 x 10/sup 19/ protons on target, no significant excess of electron neutrinos was detected. The 90% confidence limits obtained are $\Delta m^2 \leqq 0.11$ eV^2 in the limit of large mixing angle, and $\sin^2 2\theta \leqq 0.018$ in the limit of large Δm^2.

23431 Tests of time reversal in neutron-nucleus scattering. Bowman, J.D. (Los Alamos National Laboratory, Los Alamos, NM 87544, USA). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1112-1117(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Experiments to test time-reversal invariance are discussed. The experiments are based on observables constructed from the momentum and spin vectors of epithermal neutrons and from the spin of an aligned or polarized target. It is shown that the proposed tests are detailed balance tests of time-reversal invariance. The status of the experiments is briefly reviewed.

23432 Antiproton spin physics with internal polarized target. Haeberli, W. (University of Wisconsin-Madison, Madison, WI 53706). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 346-353(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

A project to insert a polarized internal hydrogen or deuterium target in LEAR is discussed. To reach the desired target thickness of 10/sup 14/ polarized atoms/cm^2 requires the use of a storage cell. Successful tests of storage cells that permit 400 wall collisions without significant depolarization are reported. The proposed spin filter experiment to partially polarize the circulating p-bar beam by spin-selective attenuation of p-bar in the polarized hydrogen target is reviewed and examples of specific planned experiments are presented.

23433 ΛLambda-bar production; experiment and theory. Presented by G. B. Franklin; Barnes; Birien, P.; Bonner, B.E.; Breunlich, W.H.; Diebold, G.; Dutty, W.; Eisenstein, R.A.; Ericsson, G.; Eyrich, W.; and others. (Carnegie-Mellon Univ.). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 354-359(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The associated strangeness production reaction p-bar+p→Lambda-bar+Λ is discussed. Recent differential cross sections and polarization data from LEAR experiment PS185 are presented and the status of the theoretical models is reviewed.

23434 Measurement of the imaginary part of the I = 1 N-barN S-wave scattering length. Mutchler, G.S.; Clement, J.; Kruk, J.; Moss, R.; Hungerford, E.V.; Kishimoto, T.; Mayes, B.; Pinsky, L.; Tang, L.; Xue, Y.; and others. (Rice University, Houston, TX 77251-1892). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 435-439(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The survival time spectrum of slow antineutrons produced in a LH_2 target has been measured. From these data the imaginary part of the I = 1 spin averaged S-wave antineutron proton scattering length has been deduced to be Im a_1 = -0.83 +- 0.07 fm. The result lies within the range of values calculated from current potential models.

23435 Probing perturbative QCD and nuclei with large angle elastic scattering. Barton, D.S.; Bunce, G.M.; Carroll, A.S.; Gushue, S.; Makdisi, Y.I.; Heppelmann, S.; Courant, H.C.; Fang, G.Y.; Heller, K.J.; Marshak, M.L.; and others. (AGS Department, Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 549-556(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The experiment reported here (AGS Exp. 834) seems particularly appropriate for a conference on the intersections of particles and nuclear physics. We have performed a new probe of aspects of perturbative QCD and the time evolution of hadrons inside nuclei. Simultaneously, we determined the momentum dependence of nuclear spectral functions. That is we measured the momentum distribution of nucleons inside nuclei with a sensitivity to components well beyond the edge of the normal Fermi distribution. (AIP)

23436 Strange quark spectroscopy from the LASS spectrometer. Aston, D.; Awaji, N.; Bienz, T.; Bird, F.; D'Amore, J.; Dunwoodie, W.; Endorf, R.; Fujii, K.; Hayashii, H.; Iwata, S.; and others. (Stanford Linear Accelerator Center, Stanford University). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 750-758(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

A brief summary is presented of results pertinent to strange quark spectroscopy derived from high statistic data on K^-p interactions obtained with the LASS spectrometer at SLAC.

23437 Partial wave analysis of the K+K-bar^0/sub π/$^-$ system produced in the reaction π$^-$p→K+K-bar^{0}π$^-$n at 8 GeV/c. Blessing, S.; Crittenden, R.; Dzierba, A.; Marshall, T.; Teige, S.; Zieminska, D.; Birman, A.; Chung, S.U.; Peaslee, D.; Fernow, R.; and others. (Physics Department, Indiana University, Bloomington, Indiana 47405). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 759-764(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We have performed a partial wave analysis of the K^+K^0/sub S/π^- system produced in the reaction $\pi^-p\rightarrow K^+K\text{-bar}^0\pi^-n$ at 8 GeV/c. We present the results of the analysis of 30,740 events in the mass range 1.24--1.60 GeV/c^2, with $0.0 \leq -t < 1.0$ GeV^2/c^2. In the 1.28 GeV/c^2 mass region, we see evidence for a J/sup P//sup G/ = 0^{-+} resonance in addition to the resonant 1^{++} wave. We observe a 0^{-+} resonance and possibly a small 1^{++} resonance in the 1.42 GeV/c^2 region. We also observe a 1^{++} state near 1.5 GeV/c^2.

23438 Investigation of resonance states in the glueball-enhanced channel πp p→phiphieta. Lindenbaum, S.J.; Foley, K.J.; Eiseman, S.E.; Etkin, A.; Hackenburg, R.W.; Longacre, R.S.; Love, W.A.; Morris, T.W.; Platner, E.D.; Saulys, A.C.; and others. (Brookhaven National Laboratory and City College of New York). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1090-1097(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

In this paper we discuss the striking evidence for the g/sub T/(2010), g/sub T/'(2300) and g/sub T/ (2340) I/sup G/J/sup P// sup C/ = 0^+2^{++} resonance which comprise virtually all of the $\pi^-p\rightarrow$phiphieta. The complete breakdown of the expected OZI suppression, and the striking differences of these states from conventional states and background in other channels has so far only been successfully explained by assuming they are produced by 1-3 2^{++} glueballs. The comparison with J/psi radiative decay results is made. The forthcoming search for an exotic J/sup P//sup C/ glueball is discussed.

23439 Analyzing power measurement in inclusive π0 production at high x/sub F/. Nessi, M. (Rice University, Houston, TX 77251). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1123-1125(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

A measurement of inclusive π^0 production has been performed with the new 185 GeV/c Fermilab polarized proton beam. First results for A/sub N/ in the x/sub F/ range between 0.2 and 0.8 and p/sub T/{similar←to}0.8 GeV/c are presented.

23440 Measurement of the deep-inelastic spin-dependent structure functions of the proton and neutron at HERA. Beck, D.H.; Filippone, B.W.; Jourdan, J.; McKeown, R.D.; Milner, R.G.; Woodward, C.E.; Freedman, S.J.; Geesaman, D.F.; Holt, R.J.; Jackson, H.E.; and others. (W. K. Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, CA 91125, USA). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1134-1139(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

It is possible to measure the deep-inelastic spin-dependent structure functions g/sup p/$_1$(x) and g/sup n/$_1$(x) for the proton

and neutron using internal polarized hydrogen, deuterium, and ^{3}He targets of polarization 50% and thickness 10/sup 14/ to 10^{15} cm^{-2} and the 60 mA longitudinally polarized 30 GeV electron beam in the HERA electron storage ring at DESY, Hamburg, W. Germany. The measurement of the deep-inelastic spin-structure of both isospin states of the nucleon at the same kinematics and using the same apparatus allows the Bjorken sum rule to be experimentally checked. In addition, it uniquely constrains the spin distribution of the u and d quarks as a function of x in any model of the nucleon. Possible target and detector configurations are described and an estimate of the accuracy of such a measurement is presented.

23441 **Spin rotation parameters A and R for π/sup +- / p elastic scattering at the onset of the Roper resonance.** Nefkens, B.M.K.; Barlow, D.B.; Kessler, R.S.; Kim, G.J.; Pillai, C.; Price, J.W.; Wightman, J.A.; Hall, S.; Lane, D.W.; Loe, S.R.; and others. (University of California, Los Angeles, CA 90024). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1151-1157(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The verification of the existing sets of πN scattering phases is sought via the determination of the A and R spin rotation parameters in π^+p and π^-p elastic scattering. The preliminary results of this first measurement of these parameters for incident pion momenta from 427 to 657 MeV/c, show agreement with the gross features of the partial-wave analyses by the groups from VPI, Karlsruhe-Helsinki, and Carnegie-Mellon-LBL. There is room for improvement.

23442 **Measurement of A and A/sub N//sub N/ in p/sub up-arrow/ p/sub up-arrow/ elastic scattering at 18.5 GeV/c.** Crabb, D.G. (Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 48109). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1163-1167(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

As part of a continuing study of spin effects in pp-interactions, we have measured the analyzing power, A, and the spin correlation parameter, A/sub N//sub N/, in pup-arrowpup-arrow elastic scattering in the p/sub perpendicular/^{2} range 1.4 to 3.35 (GeV/c)^2. The experiment was carried out using a polarized proton beam at the AGS at Brookhaven National Laboratory together with a polarized proton target. The intensity, polarization, and reliability of the polarized proton beam have improved significantly since the first commissioning in 1984. These improvements have allowed a systematic study at a single energy with good precision, rather than the more scattered measurements possible in the earlier runs. (AIP)

23443 **Is there a new pseudoscalar particle.** Samuel, M.A. (Dept. of Physics, Oklahoma State Univ., Stillwater, OK (US)). *Modern Physics Letters B;* **3**: No. 11, 1117-1123(Sep 1988).

The decay rate of orthopositronium has recently been measured in a new high precision experiment. The result is 10 standard deviations above the theoretical value. It is shown that a light neutral pseudoscalar R may resolve this discrepancy and still be consistent with the anomalous magnetic moments of the electron and the muon. If the mass m/sub R/ $\leqq$ 5.7 keV, then the existence of this proposed particle R is consistent with the beam-dump experiments. The lifetime of R is large, tau $\geqq$ 0.14 s.

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REFER ALSO TO CITATION(S) 23300, 23313, 23386, 23400, 23405, 23433, 23507, 23507, 23511, 23513, 23516, 23524, 23539, 23676, 23678, 23680, 23681, 23746

23444 **(BNL—42245) Hadronic energy spectra from nuclear collisions: Effects from collective transverse flow and the phase transition to quark matter.** Heinz, U. (Brookhaven National Lab., Upton, NY (USA)). Nov 1988. Contract AC02-76CH00016. 15p. (CONF-8810264—9). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008495/JAW.

From Conference on hadronic matter in collision; Tucson, AZ, USA (6 Oct 1988).

I give an overview of the processes determining the shape of energy spectra of hadrons emitted in relativistic nuclear collisions, and discuss how one can extract from them information on the presence of collective transverse flow and on the transition to quark-gluon matter in such collisions. 6 refs., 3 figs.

23445 **(DOE/ER/40370—T2) Final-state hyperon-nucleon interaction in kaon photoproduction from the deuteron.** Adelseck, R.A. (Ohio Univ., Athens (USA)). Jun 1988. Contract FG02-87ER40370. 145p. Ralf Anton Adelseck, Ohio University, Athens, OH.

The extraction of the hyperon-nucleon interaction from a final-state interaction process is investigated. The choice of the deuteron as a target effectively eliminates nuclear structure effects present in complex nuclei. Apart from the weak K^+N interaction, the final state exhibits a pure Λ-n interaction, which is unique to this reaction and is not available by means of AN scattering. By calculating the deuteron wave function in the framework of the Reid and Paris NN potentials, the uncertainty caused by the nucleonic wave function was determined. The size of off-shell effects was estimated by employing a completely relativistic wave function and testing several approximations. Diagrammatic techniques that included low-lying baryon and meson resonances were used to derive the photoproduction operator, which was applied to the deuteron in a spectator nucleon model. The coupling constants were obtained by a least squares fit to kaon photo- and electro-production data from the proton. Final state effects were incorporated via a distorted wave formalism. Uncertainties due to the nucleonic wave function and off-shell effects are found to be negligible, whereas the photoproduction operator shows considerable influence on the cross section. To achieve a satisfactory description of the final state interaction, partial waves up to $l = 3$ need to be included. Final state effects dominate the cross section near threshold and disappear rapidly as the energy increases. Comparison of various AN potential models display variations of up to 10%. 67 refs., 31 figs., 9 tabs.

23446 **(FNAL/C—88/184-T) Heavy quark production at collider energies.** Ellis, R.K. (Fermi National Accelerator Lab., Batavia, IL (USA)). Nov 1988. Contract AC02-76CH03000. 23p. (CONF-8806232—7). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008690/JAW.

From 7. topical workshop on proton-antiproton collider physics; Batavia, IL, USA (20 Jun 1988).

The theory of heavy quark production in QCD at collider energies is reviewed. The most important features of the recently published results on higher order corrections to the heavy quark production cross-section are described. The phenomenological consequences of these formulae for bottom and top quark production at Sp{bar p}S and Tevatron energies are presented. 22 refs., 13 figs., 1 tab.

23447 **(IFVE-ONF-OEIUNK—88-98) Single charged Higgs boson production in the models inspired by the superstring theory.** Borisov, G.V.; Larin, V.N.; Tikhonin, F.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 8p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706169/JAW.

Single charged fundamental Higgs scalars production in (e/sup +/e/sup -/)- and (ep)- collisions is studied. Consideration of an appropriate production mechanism, namely (W/sup +-/Z')-resonance scattering becomes possible due to the development of the superstring model. However the coupling constants of Z' boson with leptons and quarks dictated by the modern situation in the above theory are such that the process turns out to be observable only at very high luminosity of the future colliders (of about 5x10/sup 33/ l/cm/sup 2/ for e/sup +/e/sup -/). An effective technique for obtaining the results in an analytical form is presented in brief. 11 refs.; 4 figs.; 1 tab.

23448 (INIS-BR—1441, pp 110-117) **Nucleon excited states and unitary description of pion-nucleon scattering.** Betz, M. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica). 1986. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

A three-body unitary formulation of pion-nucleon scattering in hybrid quark models is proposed. The P/sub 11/ channel is more specifically considered and the role of the Roper resonance is discussed.

23449 (INIS-BR—1441, pp 118-122) **Short-range delta-nucleon interaction.** Ferreira, E.; Andrade, S.C.B. de; Dosch, H.G. (Pontificia Univ. Catolica do Rio de Janeiro, RJ (Brazil). Dept. de Fisica; Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). 1986. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

The PId system is used as a laboratory for a study of the ΔN interaction of short-range. The ΔN amplitudes are obtained, and one simultaneously obtains a very good description of PId elastic scattering.

23450 (INIS-BR—1441, pp 133-141) **Kaon-antikaon production in four-body PI/sup +/ p reactions at 16 GeV/c.** Amato, S.F.; Endler, A.M.F. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ). 1986. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

Through the energy distributions of the secondaries the different channels of the reaction PI/sup +/ p -> PI/sup +/ pK/sup +/ K/sup -/ at 16 GeV/c are interpreted by quark-parton diagrams. Using this framework one can expect the formation or not of resonances which are confirmed by the data analysis. The azimuthal correlation between the strange particles is observed and interpreted due to the fact that they have strange quarks not present in the beam and target particles.

23451 (INIS-BR—1441, pp 142-151) **Comments about NN-bar interaction at low energies.** Anjos, J.C.C. dos; Barroso, M.F.; Rosa, L.P.; Thome, Z.D. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ; Rio de Janeiro Univ. (Brazil). Inst. de Fisica; Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). 1986. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

Some comments about NN-bar interactions at low energies are presented, including annihilation and bound state formation near threshold. Cross sections calculation for the particular case of pp-bar, where a comparison is made with the experimental data, is performed. (L.C.).

23452 (INIS-BR—1441, pp 152) **Charge distributions, magnetization and hadronic matter observed in the proton.** Franca, H.M. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). 1986. (In Portuguese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

23453 (INIS-BR—1441, pp 153) **Pion-nucleon interaction at low energies in the Skyrme model.** Borges Filho, J.S. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1986. (In Portuguese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

23454 (INIS-BR—1441, pp 154-169) **EMC effect, overlapping bags and the nuclear shell model.** Krein, G. (Santa Maria Univ., RS (Brazil). Dept. de Fisica). 1986. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

It is shown by means of a very simple model that the hypothesis that the nucleon bag radius is larger in nuclei than in free space, in order to explain the valence-quark contribution to the EMC effect, may be in conflict with the well-established nuclear shell model for bag radii in nuclei larger than 0.9 fm.

23455 (INIS-BR—1441, pp 170-175) **Bound states of quarks and gluons.** Castro, A.S. de; Carvalho, H.F. de; Antunes, A.C.B. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1986. (In Portuguese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

Ascribing an effective mass to the gluon, the masses of quark and gluon bound states are calculated through a potential previously used in the quarkonium spectroscopy. (L.C.).

23456 (INIS-BR—1441, pp 176-185) **Cloudy bag model and meson-nuclear scattering.** Veit, E.A.; Jennings, B.K.; Thomas, A.W. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica). 1986. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

The cloudy bag model (CBM) is used to study low energy meason-baryon scattering via K-barN, KN and PIN.

23457 (INIS-BR—1441, pp 186-204) **Relativistic corrections in three-quark bound states.** Vale, M.A.B. do; Castro, A.S. de; Carvalho, H.F. de. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1986. (In Portuguese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

Using o potential which reproduces the asymptotic freedom and confinement properties of the quantum chromodynamics (QCD), the baryon, mass spectrum and the spin-dependent relativistic corrections in the ground states are calculated. (L.C.).

23458 **(INP—1297/PH) Hadronic loops and baryon spectroscopy: a new look at the old question.** Zenczykowski, P. (Institute of Nuclear Physics, Krakow (Poland)). 1985. 17p. (CONF-850721—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88706199/JAW.

From International Europhysics conference on high energy physics; Bari, Italy (18 Jul 1985).

The result of recent thorough studies of hadronic loop effects in baryon spectroscopy are presented. The crucial ingredient

of the approach adopted is the consideration of a complete set of SU(6)-related virtual two-particle intermediate states. It is shown that the old SU(6) mass formulas are well satisfied even when the hadronic cloud is taken into account. It is also argued that such long range effects constitute the dominant contribution to the observed splitting and mixing pattern of the (56,0/sup +/) and (70,1/sup -/) baryon multiplets. In particular it is demonstrated that this dominance holds true if the size of hadrons is such as assumed in the model of Isgur and Karl. For the ground-state baryons the formula relating Σ-Λ and Δ-NU mass differences - as originally derived from the single-gluon exchange by the Rujula, Georgi and Glashow - is shown to follow from hadronic loop effects as well. More generally, it is demonstrated that the observed pattern of splitting and mixing among baryons does not constitute a specific signature of the single-gluon exchange mechanism. The obtained results allow for a significantly smaller value of the QCD coupling constant α/sub s/ (.2-.3 instead of 1.0) making the one-gluon approximation better justified and resolving the apparent suppression of the spin-orbit force resulting from the single gluon exchange. 11 refs., 3 figs.

23459 **(INS—714) Perturbation theory of strongly correlated electrons with and without slave boson technique.** Nguyen Van Hieu; Ha Vinh Tan; Nguyen Toan Thang; Nguyen Ai Viet. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Oct 1988. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757228/JAW.

The Green functions of the electrons in the two-band Hubbard model with the strong on-site Coulomb repulsion were calculated by means of the perturbation theory with respect to the hopping term of the Hamiltonian. It was shown that in the slave boson technique we obtain the expressions different from the results of the calculations involving directly electron operators without using slave bosons. The physical meaning of this discrepancy was discussed.

23460 **(INS—719) Dynamical excited weak bosons and their observable signatures.** Yasue, Masaki. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Nov 1988. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757232/JAW.

Within the framework based on the local 'flavor' SU(2)/sub L//sup loc/ x U(1)/sub Y//sup loc/ symmetry, excited states of the weak bosons, W* and Z*, are regarded as boundstates of spinor constituents with the compositeness scale, Λ/sub comp/ = O(1 TeV), which are formed by the four Fermi interactions of the Nambu-Jona-Lasinio-Bjorken type. From the complementarity viewpoint, which further requires a local 'color' SU(2)/sub L//sup loc/ symmetry, it is shown that the SU(2)/sub L//sup loc/ x U(1)/sub Y//sup loc/ model with W* and Z* is equivalent to an SU(2)/sub L//sup loc/ x U(1)/sub Y//sup loc/ x SU(2)/sub L//sup loc/ model realized in the Higgs phase of SU(2)/sub L//sup loc/. The masses of the weak bosons, m/sub W,Z/, and of the excited weak bosons, m/sub W*,Z*/, satisfy m/sub W/m/sub W*/ = cosθm/sub Z/m/sub Z*/ for θ being the mixing angle of the gauge particles. Phenomenological implications of the presence of W* and Z* are discussed.

23461 **(IYaF—88-37) Photonic chiral current and its anomaly in a gravitational field.** Dolgov, A.D.; Khriplovich, I.B.; Vajnshtejn, A.I.; Zakharov, V.I. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1988. 18p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706213/JAW.

The notion of chirality for electromagnetic field which is conserved in interactions with gravitons is formulated. The corresponding chiral current is the one-particle-state analogue of the Pauli-Lubansky vector. The anomaly of this current in an external gravitational field is found. The results obtained are used for the calculation of the electromagnetic radiative correction to the fermionic chiral anomaly in a gravitational field. 20 refs.; 5 figs.

23462 **(IYaF—88-50) On the higher order QED contributions to the muon (g-2) value.** Elkhovskij, A.S. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1988. 7p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706215/JAW.

The higher order OED contributions to the muon (g-2) value are discussed. It is shown that the increase of coefficients in the QED expansion of the muon anomalous magnetic moment is mainly due to the static character of the muon field, which induces magnetic moment of the vacuum of light electrons. 8 refs.; 1 fig.

23463 **(IYaF—88-63) Instantons in QCD 2. Correlators of pseudoscalar and scalar currents.** Shuryak, E.V. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1988. 37p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706216/JAW.

The instanton-induced contributions to correlation functions in the QCD vacuum using numerical data on the ensemble of pseudoparticles (PPs) obtained previously are calculated. The hierarchy of the π, K, eta, eta' masses are explained, as well as the sign and (approximately) the magnitude of the eta-eta' mixing. All octet members have about the same coupling constants, while that for eta' seems to be larger by about 50%. The results for the I=1 scalar channel is consistent with the meson mass around 1 GeV and the coupling close to that of the pion. 15 refs.; 10 figs.

23464 **(IYaF—88-85) Chiral symmetry restoration at finite temperature in the instanton liquid.** Ilgenfritz, E.M.; Shuryak, E.V. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1988. 13p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706217/JAW.

The instanton model of the QCD vacuum quark-induced interactions to nonzero temperature is discussed. Using the mean field approximation the free energies of the two phases, the "polymer" and "molecular" ones are compared. It is found that the phase transition should happen in a narrow temperature interval around 200 MeV. 10 refs.; 3 figs.

23465 (JINR—N-1-27-88, pp 4-7) **Form factors of the decay π/sup +/->e/sup +/e/sup -/νe/sup +/.** Volkov, M.K.; Schaale, A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Akademie der Wissenschaften der DDR, Berlin-Zeuthen. Inst. fuer Hochenergiephysik). 1988. NTIS (US Sales Only), PC A03/MF A01; INIS. Order Number DE89780078/JAW.

In JINR rapid communications. Collection.

The decay π/sup +/->e/sup +/e/sup -/νe/sup +/ is studied in the quark model of superconductivity type. The calculated form factors R and the relation ξ=R/F/sub V/ are in a good agreement with experimental data. 8 refs.; 1 fig.

23466 (JINR—N-2-28-88, pp 13-20) **About a possibility of experimental investigation of topological cross sections without using film detectors.** Mandzhavidze, I.D.; Sisakyan, A.N. (AN Gruzinskoj SSR, Tbilisi. Inst. Geofiziki; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780079/JAW.

In JINR rapid communications. Collection.

Testing of the topological cross sections σ/sub n/ in n >> n-bar region is discussed for the purely electronic experiment. It is shown that calorimetrical measurements, which allow one to select events with energy of produced particles, limited from above, allow the prediction of the multiperipheral model to be checked with a high accuracy in the n > n-bar region. 2 refs.; 3 figs.

23467 (JINR—N-3-29-88, pp 18-26) **Gauge dependence of ultraviolet behaviour of QCD.** Shirkov, D.V.; Tarasov, O.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780080/JAW.

In JINR rapid communications. Collection.

As is well known, the two-loop contribution to the beta-function of the QCD running coupling a-bar/sub s/ can depend on the gauge parameter a. In this paper the results of renormalizaion-group (RG) analysis of several MOM scheme with this dependence are presented. It is shown that for some cases gauge dependence can essentially influence the ultraviolet behaviour of a-bar/sub s/

and, particularly, destroy the asymptotic freedom property. Possible "physical" implications of these phenomena are discussed. 9 refs.; 3 figs.; 1 tab.

23468 **(JINR-E—2-88-85) Diquark destruction and preasymptotical mechanisms of antiproton annihilation.** Kopeliovich, B.Z.; Zakharov, B.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; AN SSSR, Moscow. Inst. Fiziki Zemli). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1988. 21p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706225/JAW.

Submitted to the journal Yad. Fiz. .

A few preasymptotical mechanisms of N-barN annihilation are considered. Their common feature is the presence of slow quark-antiquark in the wave functions of projectile hadrons and the splitting of one or both diquarks by means of transformation from triplet to sixtet colour state. One class of annihilation mechanisms is a part of the pomeron amplitude, but another one plays a role of nonplanar shadowing to reggeon amplitude. The sum of all the mechanism contributions is in good agreement with experimentally measured annihilation cross section both in the value and in the energy dependence. 51 refs.; 6 figs.

23469 **(JINR-E—2-88-140) EMC ratio as a function of x,Q/sup 2/ in the rescaling model.** Kotikov, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. 6p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706227/JAW.

Submitted to the journal Phys. Lett. .

The ratio R/sub K,A//sup A'/=AF/sub K//sup A'/(x,Q/sup 2/)/A'F/sub K//sup A/(x,Q/sup 2/) (K=2,3) of structure functions of A and A' nuclei at x -> 0.1 in the rescaling model is considered. A simple parametrization for R/sub K,A//sup A'/ compatible with its behaviour at x ~ 0.1 is proposed. The parametrization slightly depends on Q/sup 2/ and well agrees with experimental data in the 0.2≦x≦0.7 region. 14 refs.; 1 fig.

23470 **(JINR-E—2-88-254) Next-next-to-non-leading O(α-bar/sub s//sup 3/)QCD correction to σ/sub tot/ (e/sup +/e/sup -/->hadrons): analytical calculation and estimation of the parameter Λ/sub M/-bar/sub S/-bar.** Gorishnij, S.G.; Kataev, A.L.; Larin, S.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. 18p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706228/JAW.

Submitted to the journal Phys. Lett., B.

The next-to-none leading O(a-bar/sub s//sup 3/) QCD correction to σ/sub tot/ (e/sup +/e/sup -/-> hadrons) is calculated. The obtained correction is large. For example at $\sqrt{s} \simeq 34$ GeV in the MS-scheme it is about 2.5 times larger than the previous O(a-bar/sub s//sup 2/) term. Taking into account this correction in the fit of the combined PETRA and PEP data decreases twice the value of Λ/sub MS/. The status of perturbative QCD is discussed. 29 refs.; 1 fig.

23471 **(JINR-E—2-88-336) Exotic nature of the scalar G(1590) meson.** Lanik, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. 10p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706229/JAW.

Submitted to the Intern. Seminar Quarks-88, Tbilisi, May 1988.

It is shown that the properties of the G(1590) scalar meson can be reasonably explained if this state is approximately a half-and-half mixture of gluonium gg and quarkonium qq-bar states. 23 refs.

23472 **(JINR-E—5-88-98) Efficiency of the estimators of multivariate distribution parameters from the one-dimensional observed frequencies.** Chernov, N.I.; Kurbatov, V.S.; Ososkov, G.A.; Ioseliani, Ts.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation; Tbilisskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1988. 7p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706233/JAW.

Parameter estimation for multivariate probability distributions is studied in experiments where data are presented as one-dimensional hystograms. For this model a statistics defined as a quadratic form of the observed frequencies which has a limitig x/sup 2/-distribution is proposed. The efficiency of the estimator minimizing the value of that statistics is proved whithin the class of all unibased estimates obtained via minimization of quadratic forms of observed frequencies. The elaborated method was applied to the physical problem of analysis of the secondary pion energy distribution in the isobar model of pion-nucleon interactions with the production of an additional pion. The numerical experiments showed that the accuracy of estimation is twice as much if comparing the conventional methods. 3 refs.; 1 fig.

23473 **(JINR-R—2-87-843) Investigation of the nonlinear chiral bag model (CBM) in the mean-field approximation.** Bunatyan, G.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 13p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706244/JAW.

The cloudy bag model (CBM) which contains the completely nonlinear interaction of quarks with the classical mean field is investigated for the nucleon. The equations for the bag size (R), quark momentum p, mean pion field are obtained from the boundary conditions which make sure the quark confinement and the bag stability. The expression for the total energy E of bag nucleon is obtained and investigated. By means of the properly averaging of all expressions it is possible to make all investigations in the spherical bag approach. It is shown that in the nonlinear CBM under investigation the equations for R,p,θ possess the consistent solution which corresponds to the absolute minimum of energy E and consequently there exists a stable equilibrium state of the bag nucleon. 7 refs.; 2 figs.

23474 **(JINR-R—2-88-129) Gluon bremsstrahlung and K-factors in N=1,2 supersymmetric QCD.** Darbaidze, Ya.Z.; Merebashvili, Z.V.; Slepchenko, L.A.; Matveev, V.A. (Tbilisskij Gosudarstvennyj Univ. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. 22p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706245/JAW.

Submitted to the journal Nucl. Phys. and to the Organizing Committee of the 24. International Conference on High Energy Physics, Muenchen, August 1988.

The analytical method for obtaining the matrix element squared of the (2 and 3) parton processes is developed i N=1,2 SUSY QCD as a compact product of the two factors. The physical sense of these factors is shown. Exact values of the IR radiative corrections of α/sub s//sup 3/ order QCD and N1,2 SUSY QCD are calculated in the soft bremsstrahlung gluon limit. 30 refs.; 5 figs.; 2 tabs.

23475 **(JINR-R—2-88-139) Behaviour of nonsinglet structure functions of deep inelastic scattering at x ~ 0 and x ~ 1 and their scheme-invariant parametrization.** Kotikov, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706246/JAW.

Submitted to the journal Z. Phys., C and to the Organizing Committee of the Intern. Seminar Quarks-88, Tbilisi, 1988.

Scheme-invariant behaviour of the nonsinglet structure functions of deep inelastic scattering for x->0 and x->1 is considered, and their parametrization that does not depend on the renormalization scheme is constructed. The parametrization is simple, satisfies the sum rules to the next-to-leading order of perturbation theory. Moreover, in the framework of the scheme-invariant approach there exists a simple criterion of applicability of the perturbation theory. The region of variables x and Q/sup 2/ where the expansion in the so-called scheme-invariant optimized perturbation theory if correct operation is shown. The analytical continuation of the Wilson coefficients to the half-integer n, which may be of independent interest is also given. 26 refs.; 5 figs.

23476 **(JINR-R—2-88-253) Pion form factor and δ/sub 1//sup 1/-phase of ππ-scattering in the quark confinement model.** Efimov, G.V.; Ivanov, M.A.; Mashnik, S.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; AN Moldavskoj SSR, Kishinev. Inst. Prikladnoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706248/JAW.

The pion form factor F/sub π//sup 1/(t) in the space- and time-like regions, p-wave phase of the ππ-scattering σ/sub 1//sup 1/(t) and the pion electromagnetic radius r/sub π//sup 2/=0.43 fm/sup 2/ are calculated in the quark confinement model. The comparison with experimental data and other approaches is performed. The agreement with experimental data in the region -10 GeV/sup 2/ <or approx. <or approx.3 GeV/sup 2/ is obtained. 51 refs.; 7 figs.

23477 (KEK—88-6, pp 1-11) **Comment on formation and development of quark gluon plasma.** Miyamura, Osamu. (Osaka Univ., Toyonaka (Japan). Faculty of Engineering Science). Sep 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE89780072/JAW. (CONF-8802137—).

From Workshop on physics of quark-gluon-plasma; Tsukuba, Japan (18 Feb 1988).

We have discussed formation and development of quark gluon plasma in the case of low critical temperature. It T/sub c/ is as low as 120 MeV, initial energy density of fire disk by head-on collisions at energies above several hundred GeV/amu exceeds the critical energy density. Furthermore, durations of QGP and mixed phase are comparable to that of hadronic phase in this case. These are good conditions for observation and detections of new phase. On the contrary if T/sub c/ is higher than 400 MeV, formation of new phase seems to be hard even at RHIC energies.

23478 (KEK—88-6, pp 12-20) **QCD hydrodynamics.** Mizutani, Masashi. (Waseda Univ., Tokyo (Japan). Dept. of Physics). Sep 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE89780072/JAW. (CONF-8802137—).

From Workshop on physics of quark-gluon-plasma; Tsukuba, Japan (18 Feb 1988).

The relativistic hydrodynamical model is reviewed for a phenomenological approach to quark-gluon plasma. First, we formulate the relativistic hydrodynamics by which we discuss high energy nuclear reactions. Next, we introduce transport theory based on the operator field Langevin equation we proposed. This theory provides an intermediate theoretical step from first principles, QCD, towards the phenomenolgy, the hydrodynamical model. Using our operator field Langevin equation, we derive the temperature dependence around a phase transition point of thermodynamical quantities and transport coefficients. Using these results, we solve a hydrodynamical equation for the quark-gluon system and analyse how its initially hot system approaches phase transition point.

23479 (KEK—88-6, pp 76-87) **Lattice QCD at finite temperature.** DeTar, C. (Kyoto Univ. (Japan). Research Inst. for Fundamental Physics). Sep 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE89780072/JAW. (CONF-8802137—).

From Workshop on physics of quark-gluon-plasma; Tsukuba, Japan (18 Feb 1988).

Recent progress in the numerical simulation of QCD at finite temperature is reviewed. Eight topics are treated briefly: (1) T/sub c/ scaling, (2) Equation of state, (3) Baryon susceptibility, (4) The QCD Phase Diagram, (5) J/PSI Binding in the Plasma, (6) The Screening Spectrum of the Plasma, (7) Gauge Symmetry Breaking at High T, (8) Progress in Computing Power.

23480 (KEK—88-6, pp 88-105) **Hadrons at finite temperature.** Kunihiro, Teiji. (Ryukoku Univ., Kyoto (Japan). Dept. of Natural Sciences). Sep 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE89780072/JAW. (CONF-8802137—).

From Workshop on physics of quark-gluon-plasma; Tsukuba, Japan (18 Feb 1988).

Character changes of pion and σ-meson associated with the chiral transition at finite temperature are examined on the basis of a QCD-motivated effective Lagrangian for the 2-flavour case. Brief discussions are also given on behaviours of scalar- and vector-mesons containing s-quarks and of the baryons at finite temperature. (author) 54 refs.

23481 (KEK—88-6, pp 106-115) **Hadron-quark phase transition and an excluded volume effect.** Kouno, Hiroaki; Takagi, Fujio. (Tohoku Univ., Sendai (Japan). Dept. of Physics). Sep 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE89780072/JAW. (CONF-8802137—).

From Workshop on physics of quark-gluon-plasma; Tsukuba, Japan (18 Feb 1988).

We start with an independent many phase model proposed by Cleymans et al. The following three phases are prepared independently and the critical curve for a transition between two of them is evaluated by using the Gibbs criteria: (i) the hadronic phase (H phase) where quarks and gluons are confined in color singlet hadrons and the chiral symmetry is broken spontaneously; (ii) the constituent quark phase (C phase). If one assumes that the H-phase is described by a gas of free point-like nucleons (N), antinucleons (N-bar) and pions (π), pathology emerges. We have calculated the critical curve in the T-μ plane for various values of B. See Fig.1. At a fixed μ. The results are summarized as follows: (i) the excluded volume effect is crucial to reproduce a natural phase diagram; (ii) it is easier to realize the C-phase in the high T, small μ region than in the low T, large μ region provided B is large and B/sub Q/ is not too large; (iii) a favourable value of the bag constant is B/sup 1/4/ {similar←to} 200 MeV since it gives a reasonable value for the critical temperature at μ = 0 and also for the baryon number density in the H-phase at the critical chemical potential with T = 0. Other interesting results: (iv) the stability of the normal nuclear matter gives the lower bounds 156 MeV < B/sup 1/4/, 0 < B/sub Q/; (V) for a positive B/sub Q/ and any μ, the C-phase cannot be realized at T = 0 if B/sup 1/4/ < 215 MeV. (J.P.N.).

23482 **(KEK—88-6) Proceedings of the workshop on physics of quark-gluon-plasma.** Hatsuda, T.; Chiba, J.; Miyamura, O. (eds.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Sep 1988. Vp. (CONF-8802137—). NTIS (US Sales Only), PC A07/MF A01. Order Number DE89780072/JAW.

From Workshop on physics of quark-gluon-plasma; Tsukuba, Japan (18 Feb 1988).

Individual papers are indexed separately.

23483 **(RAL—88-108) CP violating contribution to the decay K/sub L/-> π/sup 0/ e/sup +/e/sup -/.** Flynn, J.M.; Randall, L. (Rutherford Appleton Lab., Chilton (UK); California Univ., Berkeley (USA)). (Rutherford Appleton Lab., Chilton (UK)). Dec 1988. 22p. (UCB-PTH—88-29; LBL—26310). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706130/JAW.

We investigate the CP violating contribution to the decay mode K/sub L/ -> π/sup 0/ e/sup +/e/sup -/ in the standard model. We present a recalculation of the effective lagrangian involving only light quarks, working to all orders in m/sub t//m/sub W/ and computing the leading order strong interaction corrections. We argue that this calculation is sufficient for a prediction at leading order in chiral perturbation theory. We predict the branching ratio as a function of the top quark mass and KM parameters, and briefly consider nonstandard model contributions to this decay.

23484 **Triviality, anomalies, and canonical electroweak theory at small distances.** Beg, M.A.B. (The Rockefeller University, New York, New York 10021). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 8, 2373-2380(15 Apr 1989).

We consider two scenarios for rescuing canonical electroweak theory from the trap of triviality. Finite renormalization of asymptotically nonfree couplings is a feature common to

both. The first is formally consistent in that it is cutoff-free; we show, however, that it does not accommodate Adler-Bell-Jackiw anomalies and, in consequence, does not allow the process $\pi^0 \rightarrow 2\gamma$ to proceed at the observed rate. The second entails explicit introduction of a cutoff parameter Λ/sub s/ to stabilize the theory; here we find, contrary to naive expectation, that the anomalies may be retrieved if Λ/sub s/$>>$250 GeV and there need be no problem with π^0 decay. Some implications of these results are discussed.

23485 **Realistic pseudoscalar-vector Lagrangian. Static and dynamical baryon properties.** Meissner, U.; Kaiser, N.; Weigel, H.; Schechter, J. (Center for Theoretical Physics, Laboratory for Nuclear Science ge, Massachusetts 02139). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 7, 1956-1972(1 Apr 1989).

We investigate electromagnetic and axial-vector currents and the corresponding form factors as well as meson-nucleon form factors within the framework of a nonlinear chiral Lagrangian constructed by Jain, Johnson, Meissner, Park, and Schechter in Phys. Rev. D 37, 3252 (1988). We employ an unambiguous procedure to construct the electroweak current densities. This brings in a parameter, related to the $\omega \rightarrow \pi^0\gamma$ decay rate, which does not appear in the strong-interaction part of the Lagrangian. This results in a fairly accurate description of the nucleons' properties. The effects of coupling to a two-flavor "eta meson" are shown to be small.

23486 **Detecting the radiation amplitude zeros in pp$\rightarrow$Xγ and pp-bar$\rightarrow$Xγ.** Reid, J.; Samuel, M.A. (Department of Physics, University of Tulsa, Tulsa, Oklahoma 74104). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 7, 2046-2049(1 Apr 1989).

Results showing the radiation amplitude zeros in pp$\rightarrow$Xγ and p-barp$\rightarrow$Xγ are presented. There are several terms contributing to the differential cross section in each case. Some of them have the zero while some do not. Nevertheless, there remains a sizable dip which could be experimentally detected. The position of the dip provides a measure of the quark charges via real photons.

23487 **Flavor-changing decays of the Z into heavy neutrinos.** Gilman, F.J.; Rhie, S.H. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 7, 1898-1902(1 Apr 1989).

We consider flavor-changing decays of the Z boson to a fourth-generation heavy neutrino and a light neutrino, which are induced at one loop in the standard model. Such decays have a characteristic monojet signature which makes them readily distinguished experimentally, unlike flavor-changing decays involving quarks. Like other such one-loop processes, however, they are very rare when reasonable mixing angles and intermediate fermion masses are considered.

23488 **Dynamic Debye screening for a heavy-quark-antiquark pair traversing a quark-gluon plasma.** Chu, M.C.; Matsui, T. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 7, 1892-1897(1 Apr 1989).

We investigate dynamical plasma screening effects on a heavy-quark–antiquark pair traversing a quark-gluon plasma. The screened potential created by a test charge (heavy quark) moving in the plasma medium is calculated in the test charge frame by solving the transport equation for a collisionless ultrarelativistic plasma interacting via Abelian gauge field. It is shown that the screened potential becomes strongly anisotropic as the velocity of the plasma medium increases. Possible implications of this effect for charmonium production in relativistic heavy-ion collisions are discussed.

23489 **B-B-bar mixing and two-scalar-doublet model predicting a Fritzsch structure.** Gronau, M.; Johnson, R.; Schechter, J. (Physics Department, Technion, 32000 Haifa, Israel). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 7, 1913-1921(1 Apr 1989).

We investigate the Yukawa interactions of a two-scalar-doublet scheme which yields Fritzsch zeros in the mass matrices. Our motivation is to study the plausibility of obtaining the observed large B/sub d/-B-bar/sub d/ mixing without an exceptionally large t-quark mass. The difficulty with models of this type is the existence of flavor-changing neutral currents. An interesting feature of the present model is that all the relevant Yukawa couplings are determined in terms of quark masses. We show that a low-mass charged-scalar exchange cannot account for the B/sub d/-B-bar/sub d/ mixing in this model without yielding much too large a value of the CP-violation parameter ϵ. A possible exotic explanation of the large B/sub d/-B-bar/sub d/ mixing in terms of flavor-changing neutral-scalar exchange exists due to the peculiar neutral-scalar couplings arising in the model.

23490 **Axial anomaly and the proton spin.** Cheng, T.P.; Li, L. (Department of Physics, University of Missouri, St. Louis, Missouri 63121). *Physical Review Letters;* **62**: No. 13, 1441-1444(27 Mar 1989).

Several authors have noted that the forward matrix element of the axial-vector current as measured in polarized deep-inelastic electroproduction represents not only the quark contribution to the target proton spin but also the gluonic component due to the anomaly. We show that the anomalous divergence equations constrain the size of this gluonic contribution. In particular it is of such sign and magnitude that the resulting quark content of the proton spin deviates even further from the naive-quark-model expectations.

23491 **Electroweak test from the harder lepton's energy spectrum in $Z^0 \rightarrow tau^+ tau^- \rightarrow \mu^+ e^- X$.** Nelson, C.A. (Department of Physics, State University of New York at Binghamton, Binghamton, New York 13901). *Physical Review Letters;* **62**: No. 12, 1347-1349(20 Mar 1989).

The harder lepton's energy spectrum for the decay sequence $Z^0 \rightarrow tau^+ tau^- \rightarrow \mu^+ e^- X$ is sensitive to the tau-couplings parameter $\xi\alpha$/sub H/ where ξ is the Michel polarization parameter for $tau^- \rightarrow l^- \nu nu\text{-}bar$, and α/sub H/$\approx$-2a/sub tau/v/sub tau//(a^2/sub tau/+v^2/sub tau/) where a/sub tau/ and v/sub tau/ describe $Z^0 \rightarrow tau^+ tau^-$ at tree level. Due to a factorization property, radiative corrections to such energy-energy correlations are as tractable as for A/sub L//sub R/; however, this test does not require instrumentation of longitudinal beam polarization.

23492 **Conference summary.** Jaffe, R.L. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1-25(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Topics considered in the 1988 Rockport, Maine conference on Intersections Between Particle and Nuclear Physics are summarized. CP violation in K/sub L/$\rightarrow \pi\pi$, mising tau decays, Cabbibo, Kobayashi, Maskawa parameters in B-meson decay, Hanbury-Brown-Twiss correlations in high energy heavy ion collisions, application of perturbative QCD to exclusive processes, positron peaks in heavy ion collisions, mesons in the 1-2 GeV region, structure functions, cracks in the foundations of the Quark Model, inhomogeneous nucleosynthesis, and astronomy with ultraviolet energy cosmic rays are covered in this summary. (AIP)

23493 **Summary of spin physics sessions.** Roser, T. (The University of Michigan, Ann Arbor, MI 48109-1120). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 266-270(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The list of topics in the many talks given during the Spin Physics sessions of this Intersections conference is nearly as long as the one of this conference: P and T Violation NN Interaction πp and πd Elastic Scattering Nuclear Matter Spin Effects Muon (g-2) Polarized Proton Beams Polarized Gas Targets This points to the almost trivial fact that spin is fundamental to our understanding of nuclear and particle physics. I will discuss in some detail only four of these topics. Needless to say this choice is very much personally

biased and I apologize to all the speakers whose excellent contributions I did not include. (AIP)

23494 **Charmonium spectroscopy with pp-bar annihilations.** Peoples, J. (SSC Central Design Group c/o Lawrence Berkeley Laboratory University of California Berkeley, CA 94720 June 1988). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 322-327(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Charmonium, the set of bound states of a charmed quark and its antiquark, have provided considerable insight into the strong forces between quarks and antiquarks. Furthermore, improved nonperturbative QCD inspired phenomenological potential function calculations may allow extraction of a very accurate value of α_s because of all the bound states of charmonium which should be accessible to experiments using proton-antiproton annihilation. (AIP)

23495 **Nucleon-antinucleon annihilation dynamics.** Dover, C.B. (Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 370-377(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Recent progress towards a microscopic understanding of nucleon-antinucleon NN-bar annihilation is reviewed. We consider statistical models, the constraints, imposed by SU(2) or SU(3) flavor symmetry and the spin-flavor-color dependence of effective operators for the creation/destruction of quark-antiquark (QQ-bar) pairs in NN-bar annihilation process. The importance of dynamical selection rules is emphasized as a means of revealing the underlying reaction mechanism.

23496 **Spin-spin correlations in proton-proton collisions at high energy and threshold enhancements.** De Teramond, G.F. (Standford Linear Accelerator Center, Standford University, Standford, CA 94309). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 557-562(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The striking effects in the spin structure observed in elastic proton collisions and the Nuclear Transparency phenomenon recently discovered at BNL are described in terms of heavy quark threshold enhancements. The deviations from scaling laws and the broadening of the angular distributions at resonance are also consistent with the introduction of new degrees of freedom in the pp system. This implies new s-channel physics. Predictions are given for the spin effects in pp collisions near 18.5 GeV/c at large p_T where new measurements are planned.

23497 **Some implications of a possible N Nπ bound state.** Lipkin, H.J. (High Energy Physics Division Argonne National Laboratory Argonne, IL 60439 and School of Physics and Astronomy Raymond and Beverly Sackler Faculty of Exact Sciences Tel Aviv University Tel Aviv, Israel). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 581-588(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The possible properties of a π N N bound state are considered, in view of recent reports of possible experimental evidence for such a state. A six-quark T = 2 state is shown not to be bound. Strong, electromagnetic and weak decays are examined for a π N N bound state with a mass below the π N N threshold and the cases of isospin T = 2, 1 or 0. States in these multiplets with charge 0, 1 and 2 have interesting properties and might be observed as narrow resonances decaying electromagnetically, in particular states with $J^P = 1^+$ with charge 0 and 2 which are Pauli-forbidden for two nucleons. The lifetimes of the charge -1 and +3 states should be much longer than the pion lifetime because of drastically reduced phase space.

23498 **Perturbative QCD predictions for meson-baryon scattering.** Zhang, H.; Farrar, G.R. (Department of Physics and Astronomy, Rutgers University, New Brunswick, NJ 08903). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 683-690(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We have completed the leading order (order α_s^4) perturbative QCD calculation of all the quark scattering amplitudes involved in the meson-baryon scattering reactions that have been measured at Brookhaven. Ratios of differential cross sections for these reactions have been computed by convoluting the quark scattering amplitudes with hadronic wave functions. When the QCD sum-rule-derived wave functions are used, the calculation yields rough agreement with data. We have also investigated the sensitivity of the predictions to the treatment of singularities and the numerical reliability of the integration method that we used.

23499 **QCD and phenomenology of nuclear and hadronic processes at intermediate energies.** Ji, C. (North Carolina State University, Raleigh, NC 27695-8202). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 701-709(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

If one is interested in analyzing various strong interaction phenomena with the QCD Lagrangian density function based on quark and gluon degrees of freedom one might consider QCD convolution formalism as a unified approach to strong interaction phenomenology. The various phenomena include form factors of hadrons and nuclei at large momentum transfer Q and large angle scattering reactions such as photoproduction $\gamma p \to \pi^+ n$, NN scattering, photodisintegration, $\gamma d \to np$, at large angles and energies, etc.. The formalism is a convolution of quark and gluon scattering part with bound state part. The formalism has a perturbative aspect because quark and gluon scattering part can be expanded in terms of order $\alpha_s/(Q^2)$. Points of support and criticism for this 'perturbative' QCD (PQCD) phenomenology are outlined in this report. (AIP)

23500 **Threshold eta photoproduction and the role of the S_{11} resonance.** Benmerrouche, M.; Mikhopadhyay, N.C. (Department of Physics, Rensselaer Polytechnic Institute, Troy, New York 12180-3590). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 725-730(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We study the reaction $\gamma p \to etap$ with a view to examining the extraction of the $\gamma N \to S_{11}$ resonant amplitude. A difficulty to be overcome is the role of the background. We investigate it in the effective Lagrangian theory (ELT) and show that there is a large difference between pseudoscalar (PS) and pseudovector (PV) theories, as in the neutral pion case. We also study the importance of the vector meson exchanges in the t-channel and show that rho and ω contributions can be substantial. Finally, we make contact between $\gamma p \to S_{11}$ amplitude determinations from the extant analyses of the pion and eta photoproduction experiments.

23501 **Quasiparticles and spin-statistics in the deconfined phase.** Polonyi, J. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139 U.S.A.). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1030-1041(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Due to the multi-connected nature of the group of global gauge transformations of pure Yang-Mills systems the triality is permanently confined. The deconfined phase of QCD is characterized by the appearance of unusual gluon states which screen the center charge of the quarks. It is shown that chromomagnetic monopoles changes from boson to fermion as they develop triality charge in the deconfined phase. A distinguished signature of the high temperature phase of QCD is that the isolated quarks screened by the monopoles appear as bosons.

23502 **Testing the standard model with rare and forbidden decays of the eta and other light mesons.** Nefkens, B.M.K. (Department of Physics, University of California, Los Angeles, CA 90024). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 736-743(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The traditional tests of the Standard Model involving charged and neutral weak currents should be augmented with sensitive searches for new interactions and new particles such as are possible with the rare and forbidden decays of mesons, particularly the eta meson. Some examples which will be discussed are eta$\rightarrow e^+e^-$ (leptoquark), eta$\rightarrow\pi^0$H (light Higgs), eta$\rightarrow\mu e$ (lepton familty violation), eta$\rightarrow\pi^+\pi^-$ (CP violation), and eta$\rightarrow 3\gamma$ (C violation).

23503 **Y-Scaling in a simple quark model.** Kumano, S.; Moniz, E.J. (Center for Theoretical Physics, Laboratory for Nuclear Science, and Department of Physics Massachusetts Institute of Technology, Cambridge, MA 02139, and Department of Physics, University of Illinois at Urbana-Champaign, Urbana, IL 61801, and Department of Physics dand Astronomy, University of). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 498-501(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

A simple quark model is used to define a nuclear pair model, that is, two composite hadrons interacting only through quark interchange and bound in an overall potential. An "equivalent" hadron model is developed, displaying an effective hadron-hadron interaction which is strongly repulsive. We compare the effective hadron model results with the exact quark model observables in the kinematic region of large momentum transfer, small energy transfer. The nucleon reponse function in this y-scaling region is, within the traditional frame work sensitive to the nucleon momentum distribution at large momentum. We find a surprizingly small effect of hadron substructure. Furthermore, we find in our model that a simple parametrization of modified hadron size in the bound state, motivated by the bound quark momentum distribution, is not a useful way to correlate different observables.

23504 **Meson and glueball decays.** Akhoury, R. (Randall Lab. of Physics, Univ. of Michigan, Ann Arbor, MI 48109). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 862-865(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The role played by the gluon anomaly in certain Pseudoscalar meson and glueball decays is discussed. A chiral Lagrangian framework is used to calculate the hadronic decays of the eta and eta' in agreement with experiments. The gluonic production of pseudoscalar mesons is also discussed.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 23423, 23485, 23536, 23542, 23675, 23744

23505 **(FNAL/C—88/149-T) Dynamics of symmetry breaking in strongly coupled QED.** Bardeen, W.A. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1988. Contract AC02-76CH03000. 16p. (CONF-8811183—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008674/JAW.

From Nagoya workshop on new trends in strongly coupled gauge theories; Nagoya, Japan (24 Nov 1988).

I review the dynamical structure of strong coupled QED in the quenched planar limit. The symmetry structure of this theory is examined with reference to the nature of both chiral and scale symmetry breaking. The renormalization structure of the strong coupled phase is analysed. The compatibility of spontaneous scale and chiral symmetry breaking is studied using effective lagrangian methods. 14 refs., 3 figs.

23506 **Supercurrent and spontaneously broken supersymmetry.** Clark, T.E.; Love, S.T. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). *Physical Review [Section] D: Particles and Fields;* **39**: No. 8, 2391-2395(15 Apr 1989).

The conserved Noether R current, supersymmetry current, and the energy-momentum tensor are constructed in the Akulov-Volkov model of spontaneously broken supersymmetry. An improved supersymmetry current and energy-momentum tensor are defined, which, along with the chiral R current, form components of the supercurrent. The supersymmetry Wess-Zumino consistency conditions for these component currents are verified.

23507 **Radiative quark and lepton masses through soft supersymmetry breaking.** Ma, E. (Department of Physics, University of California, Riverside, California 92521). *Physical Review [Section] D: Particles and Fields;* **39**: No. 7, 1922-1924(1 Apr 1989).

A supersymmetric extension of the standard strong and electroweak gauge model has the property that light quarks and leptons acquire radiative masses as the result of the breaking of a chiral symmetry by soft supersymmetry-breaking terms. This radiative mechanism is then extended to include all known quarks and leptons in the context of a supersymmetric SU(3) x SU(2) x U(1) x U(1)' gauge model based on E_6 particle content as the possible low-energy limit of a superstring theory.

23508 **CP violation in supersymmetric models.** Branco, G.C.; Kostelecky-acute-accent, V.A. (Centro de Fisica da Materia Condensada, Av. Prof. Gama Pinto 2, 1699 Lisboa Codex, Portugal). *Physical Review [Section] D: Particles and Fields;* **39**: No. 7, 2075-2078(1 Apr 1989).

For supersymmetric extensions of the standard model, we obtain necessary conditions for CP invariance expressed in terms of weak-basis invariants. Among other applications, these conditions allow a simple identification of independent sources of CP violation and a simple exact count of CP-violating phases for any choice of couplings and masses.

23509 **Hadronic matrix elements and the πi-π^0 mass difference.** Bardeen, W.A.; Bijnens, J.; Gerard, J. (Theory Group Fermilab, P.O. Box 500, Batavia, Illinois 60510). *Physical Review Letters;* **62**: No. 12, 1343-1346(20 Mar 1989).

We estimate the π^+-π^0 electromagnetic mass difference within the 1/N expansion approach to hadronic matrix elements. Perturbative QCD and a truncated meson theory describe the high- and low-photon-loop-momentum contributions, respectively. The matching between these complementary pictures for strong interactions is discussed.

23510 **Generalized Green-Schwarz anomaly cancellation mechanism.** Tosa, Y. (Department of Physics, University of Colorado, Campus Box 390, Boulder, Colorado 80309). *Physical Review [Section] D: Particles and Fields;* **39**: No. 6, 1648-1654(15 Mar 1989).

We show that the chiral anomaly can be canceled by a single antisymmetric tensor if the anomaly form factorizes into the product of two invariant polynomials of curvature two-forms, R and F. This generalizes the Green-Schwarz cancellation mechanism, where the factorization is of the form (TrR^2-TrF^2) times an invariant polynomial. The Yang-Mills group constraints differ from those obtained by the Green-Schwarz mechanism if the anomaly form is factorized differently and thus new anomaly-free theories emerge. This generalized mechanism works for any theories in D = 4k dimensions and nonsupergravity theories in D = 4k-2. However, for supergravity-type theories in D = 4k-2 only the original Green-Schwarz factorization works. We explicitly construct many anomaly-free theories in D = 8 and D = 10, using the generalized mechanism.

23511 **Neutrino masses, mixing, moments, and matter.** Marciano, W.J. (Brookhaven National Laboratory, Upton, New York 11973). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 193-207(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The present status of neutrino masses mixing, and electromagnetic moments is surveyed. Potential enhancements of neutrino oscillations, decay, and spin-flavor precession due to their interactions with matter are described.

23512 **Electron and muon physics sessions: summary.** Montgomery, H.E. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, IL 60510). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 226-229(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

A short summary is given of the Electron and Muon Physics parallel sessions at the Conference on the Intersections of Nuclear and Particle Physics, Samoset, Maine in May 1988. The sessions occupied approximately 200 minutes, the summary occupied 15 minutes.

23513 **Summary of neutrino presentations.** White, D.H. (Los Alamos National Laboratory). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 230-240(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics: Rockport, ME, USA (14 May 1988).

This summary is divided into two sections. First, we concentrate on conventional neutrino physics interpreted in the context of standard electroweak theory. Second, we discuss double beta decay where gross violations of the predictions of the theory might appear, and also we discuss specific searches for consequences of finite neutrino mass.

23514 **Status of the search for ξ(2230).** Presented by Brian Quinn; Barnes; Birien, P.; Bonner, B.E.; Breunlich, W.H.; Diebold, G.; Dutty, W.; Eisenstein, R.A.; Ericsson, G.; Eyrich, W.; and others. (Carnegie-Mellon Univ.). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 328-333(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The present experimental status of the ξ(2230) is summarized and several possible interpretations are discussed.

23515 **Physics with thermal antiprotons.** Hynes, M.V.; Campbell, L.J. (Physics and Theory Divisions, Los Alamos National Laboratory, Los Alamos, New Mexico USA 87545). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 440-446(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The same beam cooling techniques that have allowed for high luminosity antiproton experiments at high energy also provide the opportunity for experiments at ultra-low energy. Through a series of deceleration stages, antiprotons collected and cooled at the peak momentum for production can be made available at thermal or sub-thermal energies. In particular, the CERN, PS-200 collaboration is developing an RFQ-pulsed ion trap beam line for the antiproton gravitational mass experiment at LEAR that will provide beams of antiprotons in the energy range 0.001-1000.0 eV. Antiprotons at these energies make these fundamental particles available for experiments in condensed matter and atomic physics. The recent speculation that antiprotons may form metastable states in some forms of normal matter could open many new avenues of basic and applied research.

23516 **Why the proton spin is not due to quarks.** Karliner, M. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 744-749(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Recent EMC data on the spin-dependent proton structure function suggest that very little of the proton spin is due to the helicity of the quarks inside it. We argue that, at leading order in the 1/N/sub c/ expansion, none of the proton spin would be carried by quarks in the chiral limit where mq = 0. This model-independent result is based on a physical picture of the nucleon as a soliton solution of the effective chiral Lagrangian of large-N/sub c/ QCD. The Skyrme model is then used to estimate quark contribution to the proton spin when chiral symmetry and flavor SU(3) are broken: this contribution turns out to be small, as suggested by the EMC. Next, we discuss the other possible contributions to the proton helicity in the infinite-momentum frame--polarized gluons (ΔG), and orbital angular momentum (L/sub z/). We argue on general grounds and by explicit example that ΔG = 0 and that if the parameters of the chiral Lagrangian are adjusted so that gluons carry {similar←to}50% of the proton momentum, most of the orbital angular momentum L/sub z/ is carried by quarks. We mention several experiments to test the EMC results and their interpretation.

23517 **Neutrino mass.** Kayser, B. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720 Division of Physics, National Science Foundation, Washington, D.C. 20550). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 936-938(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

An introduction is given to the search for evidence of neutrino mass.

23518 **Is there anyplace left for a massive magnetic monopole to hide?.** Groom, D.E. (SSC Central Design Group, LBL90-4040, Berkeley CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 970-975(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The search for the magnetic monopoles predicted by grand unified theories continues, with smaller number of experiments and larger number of experimenters than was the case of a few years ago. This search is complicated by a variety of attributes the monopole might possess in addition to its magnetic charge. Our precon-

ceptions about its mass and velocity are not to be trusted. It may or may not catalyze proton decay. It may have intrinsic electric charge, and if not it probably attached a proton at an early epoch. It is difficult to probe interesting flux levels with induction detectors, and the monopole's other possible attributes complicate the analysis of all other experiments and astronomical observations. In this discussion we attempt to classify the available limits according to the input assumptions.

23519 **Parity violation in proton-proton scattering at 230 MEV.** Birchall, J.; Bowman, J.D.; Davis, C.A.; Davison, N.E.; Green, P.W.; Page, S.A.; Ramsay, W.D.; Rodning, N.L.; Roy, G.; Schmor, P.W.; and others. (Department of Physics, University of Manitoba, Winnipeg, Manitoba R3T 2N2). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1105-1107(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Below {similar←to}300 MeV six meson-nucleon coupling strengths are required to describe the weak interaction of nucleons. Many experiments have found parity-violating effects in nuclear systems, but only four significant, independent constraints exist. A new measurement is proposed where measurable effects are predicted with minimal dependence on nuclear interaction models, yielding information complementary to previous results. This is a measurement of the parity-violating analyzing power. A/sub z/ in p-p scattering at 230 MeV, which is shown to be sensitive to the weak rho-nucleon coupling. This measurement, at a precision of +- 2 x 10/sup -8/, together with a proposed measurement by the University of Washington group at I.L.L. of the parity-violating neutron spin rotation, will provide the fifth and sixth independent constraints needed to determine the weak meson-nucleon coupling constants.

6454 Field Theory

REFER ALSO TO CITATION(S) 23310, 23314, 23485, 23506, 23510, 23742, 23773

23520 **(BNL—42243) Damping of QCD plasma oscillations in the Coulomb gauge.** Heinz, U. (Brookhaven National Lab., Upton, NY (USA)). Nov 1988. Contract AC02-76CH00016. 5p. (CONF-8810333—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008156/JAW.

From International workshop on thermal field theories and their applications; Cleveland, OH, USA (3 Oct 1988).

The work done by Kajantie, Toimela and the author on QCD linear response theory and the problem of damping of QCD plasma oscillations is summarized. 11 refs.

23521 **(BNL—42244) Non-equilibrium dynamics in finite-temperature QCD.** Heinz, U. (Brookhaven National Lab., Upton, NY (USA)). Nov 1988. Contract AC02-76CH00016. 18p. (CONF-8810333—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008494/JAW.

From International workshop on thermal field theories and their applications; Cleveland, OH, USA (3 Oct 1988).

An overview on the status of kinetic theory approaches to non-equilibrium dynamics in finite temperature QCD is given, and results and difficulties in determining the transport properties and equilibration time scales for a quark gluon plasma produced in nuclear collisions are discussed. 15 refs.

23522 **(FNAL/C—88/128-T) New topological invariants for non-abelian antisymmetric tensor fields from extended BRS algebra.** Boukraa, S.; Maillet, J.M.; Nijhoff, F. (Fermi National Accelerator Lab., Batavia, IL (USA)). Sep 1988. Contract AC02-76CH03000. 5p. (CONF-8806105—5). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008682/JAW.

From 17. international colloquium on group theoretical methods in physics; St. Adele, Canada (27 Jun 1988).

Extended non-linear BRS and Gauge transformations containing Lie algebra cocycles, and acting on non-abelian antisymmetric tensor fields are constructed in the context of free differential algebras. New topological invariants are given in this framework. 6 refs.

23523 **(FNAL/C—88/130-T) On the algebraic structure of integrable systems in multidimensions.** Maillet, J.M.; Nijhoff, F. (Fermi National Accelerator Lab., Batavia, IL (USA)). Sep 1988. Contract AC02-76CH03000. 5p. (CONF-8806105—6). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008697/JAW.

From 17. international colloquium on group theoretical methods in physics; St. Adele, Canada (27 Jun 1988).

The d-simplex equations are multidimensional generalizations of the Yang-Baxter (triangle) equations. We discuss the algebraic structure of the hierarchy of the d-simplex equations and their relevance to the notion of quantum and classical integrability. A multidimensional generalization of the notion of lax pair is given. 7 refs.

23524 **(FNAL/C—88/140-T) The lattice λ{phi}⁴ model with Yukawa couplings to staggered fermions.** Shigemitsu, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1988. Contract AC02-76CH03000. 6p. (CONF-8809247—7). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008675/JAW.

From Lattice '88: symposium on lattice field theory; Batavia, IL, USA (22 Sep 1988).

An investigation of the λ{phi}⁴ theory coupled via Yukawa couplings to fermions has been initiated on the lattice. Several algorithms for dynamical fermions have been tested on this model including hybrid molecular dynamic and hybrid Monte Carlo algorithms. Some preliminary results for renormalized Yukawa couplings are presented. 8 refs.

23525 **(FNAL/C—88/161-T) The status of perturbative QCD.** Ellis, R.K. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1988. Contract AC02-76CH03000. 32p. (CONF-880867—20). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008696/JAW.

From 24. international Rochester conference on high energy physics; Munich, F.R. Germany (4 Aug 1988).

The advances in perturbative QCD are reviewed. The status of determinations of the coupling constant α/sub S/ and the parton distribution functions is presented. New theoretical results on the spin dependent structure functions of the proton are also reviewed. The theoretical description of the production of vector bosons, jets and heavy quarks is outlined with special emphasis on new results. Expected rates for top quark production at hadronic colliders are presented. 111 refs., 8 figs.

23526 **(FNAL/C—88/167-T) Status of the Fermilab lattice supercomputer project.** Mackenzie, P.; Eichten, E.; Hockney, G.; Thacker, H.B.; Toussaint, D.; Atac, R.; Cook, A.; Deppe, J.; Fischler, M.; Gaines, I. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1988. Contract AC02-76CH03000. 6p. (CONF-8808145—31). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008691/JAW.

From Meeting of the Division of Particles and Fields of the American Physical Society (APS); Storrs, CT, USA (15 Aug 1988).

Fermilab has completed construction of a sixteen node (320 megaflop peak speed) parallel computer for lattice gauge theory calculations. The architecture was designed to provide the highest possible cost effectiveness while maintaining a high level of programmability and constraining as little as possible the types of lattice problems which can be done on it. The machine is programmed in C. It is a prototype for a 256 node (5 gigaflop peak speed) computer which will be assembled this winter. 6 refs.

23527 (IC—88/163, pp 2-20) **On nonlinear equations admitting soliton solutions with a "de Broglie phase".** Baby, B.V.; Barut, A.O. Sep 1988. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE89780077/JAW.

In Nonlinear de Broglie waves.

Some new classes of solutions are given for different families of nonlinear equations which have a localized envelope and a com-

plex phase factor. Energy and momentum of these solutions and their possible applications as a model of a quantum particle are discussed. (author). 16 refs, 4 figs.

23528 (INIS-BR—1441, pp 213) **Compound particle model in the stochastic electrodynamics.** Franca, H.M. 1986. (In Portuguese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

23529 **(INS—715) Path integral and operator formalism on bordered Riemann surfaces.** Ogura, Waichi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Oct 1988. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757229/JAW.

The operator formalism has been developed on the once punctured Riemann surfaces based on a generalized ground state condition in Refs. 6 - 9. Solving the boundary value problems on bordered Riemann surfaces, we show that the similar conditions are satisfied by a string state defined by the Polyakov path integral. The variational approach of Ohrndorf is confirmed in this context.

23530 **(JINR-E—2-88-136) On the impossibility of a small violation of the Pauli principle within the local quantum field theory.** Govorkov, A.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. 7p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706226/JAW.

Submitted to the journal Phys. Lett., A.

It is shown that the local quantum field theory of free fields allows only the generalizations of the conventional quantizations (corresponding to the Fermi and Bose statistics) that correspond to the para-Fermi and para-Bose statistics and does not permit "small" violation of the Pauli principle. 10 refs.

23531 **(JINR-R—2-88-164) Relativistic perturbation theory for bound states in QED and QCD.** Nguen Suan Han; Pervushin, V.N. (Moskovskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706247/JAW.

It is shown that in practice two principles are used nonexplicitly for description of bound states in QED: the quantization principle of a minimal number of physical degrees of freedom of the gauge fields, and that of stability of observed bound states. Both these principles lead to radiation gauge that is used to describe atomic levels (in the rest frame of an atom), consequently each atom has its own quantization time. The physical and mathematical principles of the relativistic perturbation theory are formulated for the description of interaction of bound states in QED and QCD. 17 refs.

23532 **(JINR-R—2-88-297) Two-dimensional density matrix and its equations. Scalar and fermionic fields.** Li Am Gir; Mal'tsev, V.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. 17p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706249/JAW.

Two-dimensional density matrix is introduced which (its Wigner transform) satisfies the system of equations: one is the Neumann equation and the other is the new equation. These equations allow one to formulate quantum field theory in the phase space and may serve as input equations of the relativistic quantum statistical mechanics. 6 refs.

23533 **(LA-UR—89-1052) Deep inelastic scaling in nuclear and particle physics.** West, G.B. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 46p. (CONF-8808206—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009377/JAW.

From International summer school on nuclear dynamics; Dronten, Netherlands (1 Aug 1988).

These lectures are intended to be a pedagogical introduction to some of the ideas and concepts concerning scaling phenomena which arise in nuclear and particle physics. Topics discussed are: classical scaling and dimensional analysis; non-relativistic treatment; dynamics and scaling; y-scaling; and relativistic treatment (QCD). 22 refs., 16 figs. (LSP)

23534 **(RRK—88-34) Stochastic quantization of nonlinear σ-models with Wess-Zumino terms.** Nakazawa, Naohito; Ennyu, Daiji. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Nov 1988. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757286/JAW.

We investigate nonlinear σ-models with Wess-Zumino terms in stochastic quantization based on the previously established superspace formulation of the stochastic background field method. In contrast with the ordinary quantization method, the one-loop corrections to the metric tensor in stochastic quantization are different depending on terms in which it appears.

23535 **(TRI-PP—88-104) From uniqueness of the standard model and going beyond.** Geng, C.Q. (TRIUMF, Vancouver, British Columbia (Canada)). Dec 1988. 3p. (CONF-8811175—2). NTIS (US Sales Only), PC A02/MF A01 - OSTI. Order Number DE89007647/JAW.

From Beyond the standard model; Ames, IA, USA (18 Nov 1988).

We argue that the resolution of the question of the uniqueness of quark and lepton representations and their charge quantizations in the standard model based on the cancellations of the three known chiral anomalies in four dimensions may hint at new physics beyond the standard model. However, it does not help with the generation problem. 14 refs., 1 tab.

23536 **Fine structure of local and axion strings.** Barr, S.M.; Hochberg, D. (Bartol Research Institute, University of Delaware, Newark, Delaware 19716). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 8, 2308-2316(15 Apr 1989).

We examine the nature of the internal structure of strings arising from field theories when a global or local symmetry is spontaneously broken. The classical dynamics of these strings is represented by effective Lagrangians in which the standard Nambu-Goto term is supplemented by additional terms that are geometric in nature. In the simplest case of the local string, the new term is just the extrinsic curvature of the world sheet. For the axion string, terms of the same order as the extrinsic curvature must be added involving the coupling of the axion to the curvature itself.

23537 **Approach to general covariance in string space of BRST string field theory.** Greensite, J.; Klinkhamer, F.R. (Department of Physics and Astronomy, San Francisco State University, San Francisco, California 94132). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 8, 2317-2321(15 Apr 1989).

We show that Becchi-Rouet-Stora-Tyutin (BRST) quantized string field theory can be made invariant under string-dependent general coordinate transformations x'/sup μ//sup σ//sup =/ = x'/sup μ//sup σ//sup =/[x(σ)], where μ = 0,1,...,D-1 and $0 \leqq \sigma_1 \leqq \pi$. This invariance is achieved by introducing a string-space metric tensor g/sub μ//sub σ//sub >1/,νσ/sub =/[x(σ)] and following the usual steps of general relativity, with the following differences: A constraint, which we term "tangent contravariance," must be imposed on the coordinate transformations and metric tensor. This restriction emerges from requiring that partial/sub σ/ x/sup μ/ transforms in string space as a contravariant vector. Further stringent constraints on the metric tensor, including Ricci flatness, arise from demanding nilpotence of the BRST charge.

23538 **Nonunique solution to the Schwinger-Dyson equations.** Bender, C.M.; Cooper, F.; Simmons L.M. Jr. (Department of Physics, Washington University, St. Louis, Missouri 63130). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 8, 2343-2349(15 Apr 1989).

In principle, a path-integral representation for a quantum field theory uniquely determines all of the Green's functions of the theory. One possible way to calculate the Green's functions is to

derive from the path-integral representation an infinite set of coupled partial differential equations for the Green's functions known as the Schwinger-Dyson equations. One might think that all nonperturbative information about the Green's functions is contained in the Schwinger-Dyson equations. However, we show that while the Schwinger-Dyson equations do determine the weak-coupling perturbation expansions of the Green's functions, the solution to the Schwinger-Dyson equations is not unique and therefore the nonperturbative content of the Green's functions remains undetermined. In particular, one cannot use the Schwinger-Dyson equations to compute high-temperature or strong-coupling expansions.

23539 **1/sup --/→0/sup -+/ meson radiative and pionic transitions and mass splittings.** Slaughter, M.D.; Oneda, S. (Mail Stop B283, Medium Energy Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 7, 2062-2065(1 Apr 1989).

Radiative and pionic transitions between the ground-state pure qq-bar vector and pseudoscalar mesons compatible with observed mass splittings are studied.

23540 **Realization of stochastic phase-space quantization on a collective field theory.** Ktorides, C.N.; Papaloucas, L.C. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 7, 3310-3315(1 Apr 1989).

We consider the collective-field-theoretical description of a many-body quantum system (one dimensional for simplicity). We show how the stochastic phase-space quantization prescriptions can be applied to such a system. We define integration measures for the inner product and prove, constructively, that it is not necessary to employ effective quantities (e.g., effective action, Hamiltonian, etc.) in this scheme, unlike the conventional formulation of collective field theory. We offer intuitive interpretations of these results in terms of particle spreading and minimum uncertainty. A specific, simple example is explicitly worked out.

23541 **Toward a quantum chromodynamical derivation of nuclear physics.** Miller, G.A. (Institute for Nuclear Theory, Department of Physics, FM-15, University of Washington, Seattle, Washington 98195). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 4, 1563-1582(Apr 1989).

The connection between the strong-coupling approximation to quantum chromodynamics and nuclear properties observed at low and medium energies and momentum transfer is examined. The strong-coupling approximation to quantum chromodynamics indicates that, for nuclei, the Pauli principle is obeyed at the hadronic level, so that quarks in different hadrons are treated as distinguishable objects. Furthermore, the gluonic effects of flux-tube rearrangement are small. Instead, a more significant strong-coupling approximation to quantum chromodynamics string-breaking term leads to meson emission from baryons. This mechanism is used to compute meson-nucleon and delta coupling constants and form factors. Qualitative agreement with experiment is achieved. Thus the strong-coupling approximation to quantum chromodynamics reproduces the salient features of the meson-baryon picture of low momentum transfer nuclear physics.

23542 **Toy superstrings.** Corvi, M.; Kostelecky-acute-accent, V.A.; Moxhay, P. (Physics Department, Indiana University, Bloomington, Indiana 47405). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 6, 1611-1625(15 Mar 1989).

Superstrings with critical dimension two and two real bosonic spacetime coordinates may serve as useful toy models for the study of string properties. We present details of several such toy superstrings including open, closed, and heterotic models. Conformal methods are used to establish the spectrum and dimensionality. The spin fields are provided and Becchi-Rouet-Stora-Tyutin-(BRST-) invariant vertex operators are constructed. Four-point tree-level and four-point one-loop amplitudes in these models are obtained. The closed and heterotic toy superstrings are shown to be modular invariant to this order.

23543 **Gauged Q balls.** Lee, K.; Stein-Schabes, J.A.; Watkins, R.; Widrow, L.M. (Theoretical Physics Group, Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 6, 1665-1673(15 Mar 1989).

Classical nontopological soliton configurations are considered within the theory of a complex scalar field with a gauged U(1) symmetry. Their existence and stability against dispersion are demonstrated and some of their properties are investigated analytically and numerically. The soliton configuration is such that inside the soliton the local U(1) symmetry is broken, the gauge field becomes massive, and for a range of values of the coupling constants the soliton becomes a superconductor pushing the charge to the surface. Furthermore, because of the repulsive Coulomb force, there is a maximum size for these objects, making impossible the existence of Q matter in bulk form. We also briefly discuss solitons with fermions in a U(1) gauge theory.

23544 **Operator-product expansion with spontaneously broken symmetry.** Brown, L.S.; Lee, T. (Physics Department, FM-15, University of Washington, Seattle, Washington 98195). *Annals of Physics (New York);* **189**: No. 2, 432-460(1 Feb 1989).

The operator-product expansion is a most important tool in quantum field theory, and it is often employed in theories that have a spontaneously broken symmetry such as QCD where chiral symmetry is broken. Claims have been made that the operator-product expansion does not apply to theories with a spontaneously broken symmetry. Although these claims have been previously rebutted, none of these works provide a precise and careful definition of the needed renormalized composite operators and of the operator-product expansion. This we do here for the simple case of scalar field theory. We show explicitly for the first two orders of perturbation theory that operator-product expansion does hold for the spontaneously broken theory for the case of the two-point Green's function. This we do both for the case of a single scalar field and also for the O(N) linear σ-model. copyright 1989 Academic Press, Inc.

23545 **Explicit solutions for the running coupling constant and the separatrix of quantum field theories.** Khuri, N.N.; Ren, H.C. (Rockefeller University, New York, New York 10021). *Annals of Physics (New York);* **189**: No. 1, 142-154(Jan 1989).

Starting with 't Hooft's definition of a renormalized coupling constant, we give an explicit solution for the running coupling constant. We also give an exact expression for the "separatrix" of a quantum field theory, i.e., the line that separates the asymptotically free region of the g-plane from the nonasymptotically free one. Our results hold for all four dimensional renormalizable theories such as QCD, QED, and phi$^4_4$. The implication of the results is discussed. copyright 1989 Academic Press, Inc.

23546 **Geometric structures of super-(Diff(S^1)/S^1)*.** Schmidke, W.B.; Vokos, S.P. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Annals of Physics (New York);* **189**: No. 1, 190-222(Jan 1989).

Superconformal invariance is of central importance to a perturbative and non-perturbative formulation of stringy theory. The group that describes the invariances of the superstring is the super-Virasoro group, Super-Diff(S^1). The super-reparameterizations of the circle that leave a point fixed compose the quotient space Super-(Diff(S^1)/S^1). We investigate the holomorphic geometry of this infinite-dimensional Kaehler supermanifold and calculate its curvature. copyright 1989 Academic Press, Inc.

23547 **Topological defects and differential structures.** Rohm, R. (California Institute of Technology, Pasadena, California 91125). *Annals of Physics (New York);* **189**: No. 1, 223-239(Jan 1989).

Topological defects arising from nontrivial differential structures on space-time are considered. Methods of classifying and distinguishing exotic differential structures are discussed, as are possible physical manifestations. copyright 1989 Academic Press, Inc.

65 PHYSICS II

REFER ALSO TO CITATION(S) 23256, 23257, 23258, 23259, 23260

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 22081, 23018

23548 **(ANL/NDM—92) Nuclear data uncertainties: I, Basic concepts of probability.** Smith, D.L. (Argonne National Lab., IL (USA)). Dec 1988. Contract W-31109-ENG-38. 227p. NTIS, PC A11/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008789/JAW.

Some basic concepts of probability theory are presented from a nuclear-data perspective, in order to provide a foundation for thorough understanding of the role of uncertainties in nuclear data research. Topics included in this report are: events, event spaces, calculus of events, randomness, random variables, random-variable distributions, intuitive and axiomatic probability, calculus of probability, conditional probability and independence, probability distributions, binomial and multinomial probability, Poisson and interval probability, normal probability, the relationships existing between these probability laws, and Bayes' theorem. This treatment emphasizes the practical application of basic mathematical concepts to nuclear data research, and it includes numerous simple examples. 34 refs.

23549 **(BNL—42242) Initial experiments with the Nevis Cyclotron, the Brookhaven Cosmotron, the Brookhaven AGS and their effects on high energy physics.** Lindenbaum, S.J. (Brookhaven National Lab., Upton, NY (USA); City Coll., New York (USA)). 1988. Contract AC02-76CH00016;AC02-83ER40107. 31p. (CONF-8809183—1). NTIS, PC A03 - OSTI. Order Number DE89008148/JAW.

From International conference on restructuring of physical sciences in Europe and the United States, 1945-1960; Rome, Italy (19 Sep 1988).

The first experiment at the Nevis Cyclotron by Bernardini, Booth and Lindenbaum demonstrated that nuclear stars are produced by a nucleon-nucleon cascade within the nucleon. This solved a long standing problem in Cosmic rays and made it clear that where they overlap cosmic ray investigation would not be competitive with accelerator investigations. The initial experiments at the Brookhaven Cosmotron by Lindenbaum and Yuan demonstrated that low energy pion nucleon scattering and pion production were unexpectedly mostly due to excitation of the isotopic spin = angular momentum = 3/2 isobaric state of the nucleon. This contradicted the Fermi statistical theory and led to the Isobar model proposed by the author and a collaborator. The initial experiments at the AGS by the author and collaborators demonstrated that the Pomeronchuck Theorem would not come true till at least several hundred GeV. These scattering experiments led to the development of the "On-line Computer Technique" by the author and collaborators which is now the almost universal technique in high energy physics. The first accomplishment which flowed from this technique led to contradiction of the Regge pole theory as a dynamical asymptotic theory, by the author and collaborators. The first critical experimental proof of the forward dispersion relation in strong interactions was accomplished by the author and collaborators. They were then used as a crystal ball to predict that "Asymptopia"---the theoretically promised land where all asymptotic theorems come true---would not be reached till at least 25,000 BeV and probably not before 1,000,000 BeV. 26 refs., 11 figs., 2 tabs.

23550 **(BNL-NCS—41884) Ground state spontaneous fission half-lives from thorium to fermium.** Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). [1988]. Contract AC02-76CH00016. 6p. (CONF-890406—4). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89002183/JAW.

From Fifty years with nuclear fission conference; Gaithersburg, MD, USA (25 Apr 1989).

Measurements of the half-lives for spontaneous fission of the nuclidic ground states of elements from thorium to fermium have been compiled and evaluated. Recommended values are presented. An attempt has been made to distinguish between spontaneous fission and heavy ion emission. Spontaneously fissioning isomers have not been considered here. The difference between even-even nuclides and odd-even, even-odd and odd-odd nuclides are discussed. 3 tabs.

23551 **(BNL-NCS—51771-Ed.1-Suppl.4) Integral charged particle nuclear data bibliography: Literature scanned from April 11, 1987 through November 10, 1988.** Holden, N.E.; Ramavataram, S. (National Nuclear Data Center, Upton, NY (USA)). Dec 1988. Contract AC02-76CH00016. 59p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008964/JAW.

This publication is the annual supplement to the first edition published in 1984. The primary goal of this publication has been to satisfy the need expressed by the Nuclear Reaction Data Center Network for a concise and comprehensive bibliography of integral charged-particle cross section data. The reader is referred to a partial list of other bibliographies relevant to charged-particle-induced reaction data and to "A Source List of Nuclear Data Bibliographies, Compilations, and Evaluations" for a more comprehensive list. Since this publication is not cumulative, earlier versions are also shown in this paper. This publication makes use of a modification to the database of the Nuclear Structure References (NSR) file. This modification allows the retrieval of integral charged particle nuclear data entries from the NSR file. In recent years, the presentation of various sections was changed, as a result of users' suggestions. The authors continue to welcome users' comments. 190 refs., 3 tabs.

23552 **(CONF-880912—27) Radiochemistry of the fission products.** Steinberg, E.P. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 40p. NTIS, PC A03 - OSTI. Order Number TI89007507/JAW.

From 196. American Chemical Society national meeting; Los Angeles, CA, USA (25 Sep 1988).

This paper discusses the historical aspects of the radiochemistry of fission products. 20 figs., 2 tabs. (LSP)

23553 **(DOE/ER/40048—216-L9) Fission: The first 50 years.** Vandenbosch, R. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). [1989]. Contract AC06-81ER40048. 11p. (CONF-890198—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008208/JAW.

From International conference on nuclear reaction mechanism; Calcutta, India (3 Jan 1989).

The possibility of fission had been largely unanticipated prior to its discovery in 1938. This process, with its dramatically large energy release and its formation of previously unknown nuclides, immediately captured the imagination of the scientific community. Both theoretical and experimental developments occurred at a rapid pace. I will begin my discussion of fission with the far-reaching paper of Bohr and Wheeler, who in little more than half a year laid out a framework for understanding many features of the fission process. I will then turn to our current understanding of a number of aspects of fission. One of these is the pronounced tendency of many nuclear species to fission asymmetrically. In fact, the discovery of fission was based on the identification of barium isotopes produced in asymmetric fission. The dramatic changes in the preferred mass division and kinetic energy release with the addition of only a few neutrons to the spontaneously fissioning Fermium isotopes will be emphasized. The problem of the dynamics of saddle to scission will be discussed---this is one aspect of fission for which we do not have all the answers. Another dynamical effect to be discussed is the apparent failure of transition state theory at high excitation energies. The role of single particle (shell) effects in enriching the structure if the potential energy surface will be explored. Spontaneously fissioning isomers and intermediate structure resonances will be discussed. The recognition that short-lived fission isomers are superdeformed shape isomers has been followed by the recent observation of superdeformed shape isomers in the rare earth region. 18 refs., 3 figs.

23554 **(DOE/ER/40345—9) Nuclear orientation and nuclear structure.** Krane, K.S. (Oregon State Univ., Corvallis (USA). Dept. of Physics). 1988. Contract FG06-87ER40345. 13p. (CONF-8808161—5). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008213/JAW.

From Workshop on on-line nuclear orientation and related topics; Oxford, UK (31 Aug 1988).

The present generation of on-line nuclear orientation facilities promises to revolutionize the gathering of nuclear structure information, especially for the hitherto poorly known and understood nuclei far from stability. Following a brief review of the technological developments that have facilitated these experiments, the nuclear spectroscopic information that can be obtained is summarized. Applications to understanding nuclear structure are reviewed, and challenges for future studies are discussed. 14 refs., 4 figs., 3 tabs.

23555 **(INDC(SEC)—095/URSF) WRENDA 87/88: World request list for nuclear data.** Wang Dahai (ed.). (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Aug 1988. 150p. NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS. Order Number DE88705728/JAW.

Published on behalf of the National Nuclear Data Centre, Brookhaven, USA (M.R. Bhat, Coord.); the NEA Data Bank, Saclay, France (N. Tubbs, Coord.); the Nuclear Data Section, Vienna, Austria (Wang Dahai, Coord.); the Nuclear Data Center, Obninsk, USSR (O.D. Kazachkovskij, Coord.).

WRENDA 87/88 is the ninth edition of the World Request List for Nuclear Data. This list is produced from a computer file of nuclear data requests, maintained by the Nuclear Data Section of the International Atomic Energy Agency (IAEA). The requests are provided by official bodies, such as national nuclear data committees, through four regional data centers serving all Member States of the IAEA. Each request included indicates: that the estimated accuracy of the nuclear data available does not satisfy the requirements encountered, and that, consequently, new data measurements and/or data evaluations with improved accuracy are highly desirable. WRENDA is intended to serve as a guide to experimentalists, evaluators and administrators when planning nuclear data measurement and evaluation programs. The requests in this edition come from 18 different countries and one international organization.

23556 (INIS-SU—68, pp 541) **Evaluated parameters of nuclide radiative decay, incoming to RSGS.** Danilenko, V.N.; Kuz'menko, N.K.; Matveev, S.V. and others. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

23557 **(JINR—R-1-88-110) Anomalous component of absorption function of relativistic fragments produced in interactions of magnesium nuclei with plexiglas at 4.5 A GeV/c.** Karev, A.G.; Morozov, B.A.; Petukhov, Yu.P.; Povtorejko, A.A.; Sukhanov, A.Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706238/JAW.

Submitted to the journal Yad. Fiz.

The data analysis of 4.5 A GeV/c /sup 24/Ng nuclear fragmentation experiment using a Cherenkov stack spectrometer indicates the anomalous component of absorption function of projectile fragments. The mean free part of normal and anomalous components in the plexiglas media for fragments $6 \leqq Z \leqq 10$ is estimated to be λ/sub n/=(141.7+-1.9) mm and λ/sub a/=(1.9+-0.8) mm. The anomalous admixture fixed λ/sub a/=2mm is α=0.084+-0.027. The estimations of parameters remain stable when applying various selection criteria. 12 refs.; 6 figs.; 4 tabs.

23558 **(JINR—R-1-88-215) Spectra of π/sup +-/ mesons and protons in central and peripheral collisions of p, /sup 12/C, /sup 22/Ne with photoemulsion nuclei at 4.5 A GeV/c.** Vokal, S.; Tolstov, K.D.; Shabratova, G.S.; Leskin, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; AN Tadzhikskoj SSR, Dushanbe. Fiziko-Tekhnicheskij Inst.). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. 13p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705811/JAW.

Spectra of relativistic π/sup +-/-mesons and protons undergoing interaction in inelastic collisions of p, /sup 12/C, /sup 22/Ne with photoemulsion nuclei are considered. The ratio of particle yield in g-fragment ensemble of /sup 22/Ne nuclei at rest have been found. Experimental results are compared with the predictions of cascade-evaporation model for /sup 22/Ne+ emulsion interaction. It is shown that P/sub 1/ spectra of π/sup +-/-mesons and protons consist of two components. Average transverse momentum of highly excited proton source in /sup 22/Ne+ emulsion interactions and in events of total disintegration of Ag. Br nuclei are similar. Thermolization feature is fulfilled for protons from these events, the yield of π/sup +-/-mesons to proton is by 50% more than this value in peripheral collisions. 19 refs.; 2 figs.; 6 tabs.

23559 **(JINR—R-1-88-252) Topological characteristics of /sup 28/Si nuclei fragmentation at 4.5 A GeV/c.** Krasnov, S.A.; Tolstov, K.D.; Shabratova, G.S. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706242/JAW.

The analysis of the charge content of /sup 28/Si fragmentation on photoemulsion nuclei has been carried out. The topological characteristics of the fragmentation, multiplicity and charge content of fragments for different emulsion components have been obtained. The dependence of the degree of silicon disintegration on the size of its spectator part has been investigated. The probability of the total silicon disintegration for different components of emulsion and the formation probability of two multicharged fragments have been estimated. The fragment charge distributions from the experiment are compared with similar ones of the percolation model. 12 refs.; 7 figs.; 4 tabs.

23560 **(JINR-R—1-88-175) Fragmentation cross sections of /sup 19/F at 4 A GeV/c.** Golovin, V.M.; Golutvin, I.A.; Dolya, S.N. and others. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1988. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705808/JAW.

Submitted to the journal Pis'ma Zh. Ehksp. Teor. Fiz. and to the Organising Committee of the 3-d International conference on Nucleus-nucleus interactions, France, 1988.

The fragmentation of /sup 19/F->/sub z/A/sub f/ (δz=1, 2, 3, 4, $\geqq$5) at 4 A GeV/c was investigated on C, Al, Cu, In, W, Bi and U targets. The trajectory of incident ions was measured by proportional chambers, while the charges of incident and progectile fragments were measured by Cherenkov detectors. The cross section dependence upon the atomic number of a nucleus-target was studied, and the contribution of the Coulomb mechanism of fragmentation was evaluated. 8 refs.; 5 figs.; 1 tab.

23561 **(LA—11534-T) Evaluation and application of delayed neutron precursor data.** Brady, M.C. (Los Alamos National Lab., NM (USA)). Apr 1989. Contract W-7405-ENG-36. 275p. NTIS, PC A12/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009586/JAW.

Up to 1300 nuclides are yielded in fission. Of these, 271 have been identified as precursors for delayed neutron emission. An extensive reference library of delayed neutron data has been compiled which contains fission yields and branchings, delay neutron emission probabilities and spectra for each of these 271 precursor nuclides. The emphasis of the present work has been in improving the spectral data. Experimental spectra from laboratories in the United States, Germany, and Sweden have been incorporated in this evaluation. The experimental spectra have been augmented with model

calculations such that the spectra included in the final library extend over the full theoretical energy range for delayed neutron emission. Models were also used to predict spectra for nuclides with no measured data. The data compiled in the precursor library have been used to calculate the aggregate behavior of delayed neutrons for the 43 fissioning systems having evaluated fission yields. Delayed neutron activities predicted using the explicit precursor data have also been approximated by three, six, nine and twelve time-groups using least squares techniques. The fitted six group data, being the more conventional representation, were also used to predict a consistent set of six-group spectra. Comparisons with the University of Lowell's recently published measurements of ^{235}U delay interval spectra were also made. Beta-effective calculations for a simple Godiva system were performed and were compared to the experimental value.

23562 **(LA-UR—88-3321) Calculated medium-energy fission cross sections.** Arthur, E.D.; Young, P.G. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-890406—3). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89002046/JAW.

From Fifty years with nuclear fission conference; Gaithersburg, MD, USA (25 Apr 1989).

Calculations were made of neutron-induced fission cross sections on ^{238}U and ^{237}Np to compare with new data available up to 100 MeV. This process also produced fission barrier parameters for neptunium and uranium compound systems required for calculation of p + ^{238}U fission cross sections. To achieve reasonable agreement with higher energy neutron-induced fission data, a phenomenological enhancement to barrier heights based upon the average angular momentum of the compound system was required. These calculational procedures resulted in predictions of $^{238}U(p,f)$ cross sections that agree well with available data. 7 refs., 2 figs.

23563 **(LA-UR—89-821) Fundamental symmetry studies at Los Alamos using epithermal neutrons.** Bowman, C.D.; Bowman, J.D.; Yuan, V.W.; Herczeg, P.; Szymanski, J.; Mortenson, R.N.; Anaya, J.M.; Postma, H.; Delheij, P.P.J.; Baker, O.K. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 21p. (CONF-8810175—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009398/JAW.

From JOWOG 39-manufacturing technology - SUBWOG F-robotics conference; Santa Fe, NM, USA (4 Oct 1988).

Fundamental symmetry studies using intense polarized beams of epithermal neutrons are underway at the LANSCE facility of the Los Alamos National Laboratory. Three classes of symmetry experiments can be explored: parity violation, and time reversal invariance violation for both parity-violating and parity-conserved observables. The experimental apparatus is described and performance illustrated with examples of recent measurements. Possible improvements in the facilities and prospective experiments are discussed. 15 refs., 10 figs.

23564 **(ORNL—6508) Physics Division progress report for period ending September 30, 1988.** Livingston, A.B. (ed.). (Oak Ridge National Lab., TN (USA)). Mar 1989. Contract AC05-84OR21400. 309p. NTIS, PC A14/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008978/JAW.

This report covers the research and development activities of the Physics Division for the 1988 fiscal year, beginning October 1, 1987, and ending September 30, 1988. The activities of this Division are concentrated in the areas of experimental nuclear physics, experimental atomic physics, and theoretical nuclear and atomic physics. Operation of the Holifield Heavy Ion Research Facility as a national user facility continues to represent the single largest activity within the Division. This year saw the completion of the acceleration tube upgrade of the 25-MV tandem electrostatic accelerator and the achievement of record terminal potentials, operation for an experiment with 25 million volts on terminal, and successful tests with beam at 25.5 MV. The experimental nuclear physics program continues to be dominated by research utilizing heavy ions. These activities, while continuing to center largely on the Holifield Facility, have seen significant growth in the use of facilities that provide intermediate energies and especially ultrarelativistic beams. The UNISOR program, since its inception, has been intimately associated with the Division and, most particularly, with the Holifield Facility. In addition to the Holifield Facility, the Division operates two smaller facilities, the EN Tandem and the ECR Ion Source Facility, as "User Resources." The efforts in theoretical physics, covering both nuclear and atomic physics, are presented. In addition to research with multicharged heavy ions from the ECR source, the effort on atomic physics in support of the controlled fusion program includes a plasma diagnostics development program. The concentration of this program on optical and laser technology is marked by the change in designation to the Laser and Electro-Optics Lab. A small, continuing effort in elementary particle physics, carried out in collaboration with the University of Tennessee, is reported.

23565 **Recent references September through December 1988.** Ramavataram, S. (Brookhaven National Laboratory, Upton, New York 11973, USA). *Nuclear Data Sheets;* **56**: No. 3, 449-449(Mar 1989).

An index of nuclear properties and nuclear reactions is presented for literature received by the National Nuclear Data Center or assigned keywords between September and December 1988. (AIP)

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 23418, 23492

23566 **New results from the Brookhaven and CERN heavy ion programs.** Zajc, W.A. (Columbia University, New York, NY 10027). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 88-102(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Recent results from the Brookhaven and CERN heavy ion programs are presented. The motivation for using nuclear beams is briefly discussed, followed by an analysis of some of these early data.

23567 **Nuclear quasielastic response.** Lourie, R.W. (Department of Physics and Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, MA 02139). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 103-121(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

At intermediate energies, all nuclei exhibit a broad peak in their inelastic electron scattering response in which incoherent scatterings from individual nucleons play a major role. Description of this response relies on both an understanding of the nuclear many-body problem with its consequent multiparticle correlation physics as well as knowledge of the appropriate elementary-particle degrees of freedom from which to construct the nucleus. A review will be given of the progress achieved in these areas by means of both inclusive and coincidence electron scattering experiments. Some current theoretical approaches will also be described.

23568 **Particle production results from helios.** Jacak, B. (Los Alamos National Laboratory, Los Alamos NM, 87545). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1009-1016(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The availability of ultrarelativistic heavy ion beams at CERN and Brookhaven allows investigation of the physical properties of a state of high energy density in nuclear matter. The interest is driven by the expectation that confinement of the partons in a hadron cannot survive when the density of hadrons is large compared to the density inside ordinary hadrons. This prospect is supported by QCD calculations, and collisions between heavy nuclei at ultrarelativistic energies are predicted to provide the energy densi-

ties required for deconfinement (greater than 2--3 GeV/fm^3). Among the goals of the first experiments are investigation of the energy density and spatial extent of the highly excited central rapidity region to address whether the necessary conditions have been satisfied, and a closer examination of events with large amounts of energy deposited in the target. The HELIOS (High Energy Lepton and Ion Spectrometer) experiment therefore combines 4π calorimetric coverage with measurement of charged particle multiplicity, inclusive particle spectra, two particle correlations, lepton pairs and photons. (AIP)

6512 Nuclear Properties And Reactions, A=1-5, Experimental

23569 Systematics of charge-pickup reactions by GeV/nucleon heavy nuclei. Ren Guoxiao; Price, P.B.; Williams, W.T. (Physics Department, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 4, 1351-1358(Apr 1989).

We have measured cross sections for inclusive reactions in which 1.7 GeV/N /sup 56/Fe, 1.46 GeV/N /sup 84/Kr, 1.28 GeV/N /sup 139/La, and 0.8 GeV/N /sup 197/Au increased in charge by one unit. Combining these results with data on charge pickup by /sup 12/C, /sup 18/O, and /sup 20/Ne projectiles, we find that the cross section for charge pickup by {similar←to}GeV/nucleon projectiles is generally given to within a factor of 2 by the expression σ/sub Δ//sub Z//sub //sub = //sub +1/ = 1.7 x 10/sup -4/ γ/sub P//sub T/A/sub P/^{2} (in mb), where γ/sub P//sub T/ = A/sub P//sup 1/3/ +A/sub T//sup 1/3/-1.0. This expression, with roles of projectile and target interchanged, equally well fits cross sections for (p,xn) reactions at GeV energies when summed over x. The factor γ/sub P//sub T/ implies peripheral collisions; the dependence on A/sub P/^{2} is the steepest ever reported for a nuclear process.

23570 Energy of the 32-keV transition of /sup 83/Kr/sup m/ and the atomic mass difference between ^{3}H and ^{3}He. Staggs, S.T.; Robertson, R.G.H.; Wark, D.L.; Nguyen, P.P.; Wilkerson, J.F.; Bowles, T.J. (Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 4, 1503-1510(Apr 1989).

The energy of a gamma transition in the decay of /sup 83/Kr/sup m/ has been determined to be 32 147.3(16) eV in a comparison with transitions in /sup 241/Am decay. This value, substantially more precise than previous ones, leads to a corresponding improvement in precision in the atomic mass difference between ^{3}H and ^{3}He as determined from an experiment on the beta decay of free molecular tritium. The mass difference, 18 589.0(26) eV, is in agreement with some independent determinations but disagrees with others, most notably with some recent ion-cyclotron-resonance data. The latter disagreement calls into question the 17-eV lower limit on the mass of the electron antineutrino claimed by Boris et al.

23571 Electroexcitation of the Δ(1232) in nuclei. Sealock, R.M.; Giovanetti, K.L.; Thornton, S.T.; Meziani, Z.E.; Rondon-Aramayo, O.A.; Auffret, S.; Chen, J.; Christian, D.G.; Day, D.B.; McCarthy, J.S.; and others. (Institute of Nuclear and Particle Physics and Department of Physics, University of Virginia, Charlottesville, Virginia 22901). *Physical Review Letters;* **62**: No. 12, 1350-1353(20 Mar 1989).

Inclusive electron-scattering measurements of Δ electroexcitation in nuclei are reported. Electrons with energies of 0.96, 1.1, 1.3, and 1.5 GeV were scattered from ^{1}H, ^{4}He, C Fe, and W at 37.5°, corresponding to Q^2 = 0.20--0.52 (GeV/c)^2 at the Δ peak. The centroid of the Δ-region cross-section peak is above that for the free nucleon and it shifts to higher invariant mass as Q^2 increases. The A dependence in the dip region and ratios of nuclear to nucleon integrated cross sections indicate that at these Q^2 values there is little specifically nuclear, e.g., quasideuteron, background contribution.

23572 Neutron-proton analyzing power measurements from 375 to 775 MeV. Newsom, C.R.; Hollas, C.L.; Ransome, R.D.; Riley, P.J.; Bonner, B.E.; Boissevain, J.G.J.; Jarmer, J.J.; McNaughton, M.W.; Simmons, J.E.; Bhatia, T.S.; and others. (University of Texas, Austin, Texas 78712). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 3, 965-974(Mar 1989).

As part of an experimental study of the nucleon-nucleon interaction at medium energy, the free neutron-proton analyzing power A/sub n/(θ/sub n//sup */,T/sub n/) has been measured at nine incident neutron energies in the range 375≦T/sub n/≦775 MeV and for neutron c.m. angles in the range 57°≦θ/sub n//sup */≦159°. Unpolarized neutrons with a broad continuum of energies, produced by interaction of an 800 MeV proton beam with a beryllium target, were scattered from a polarized proton target. At each angle, for the whole energy region, the scattered neutron and conjugate recoil proton were detected in coincidence. A previously unseen minimum is observed in the energy dependence of A/sub n/(θ/sup */{similar←to}100°) near 625 MeV.

23573 Transverse inelastic electron scattering from the deuteron at high momentum transfers. Bosted, P.E.; Arnold, R.G.; Benton, D.; Clogher, L.; DeChambrier, G.; Katramatou, A.T.; Lambert, J.; Lung, A.; Petratos, G.G.; Rahbar, A.; and others. (The American University, Washington, D. C., 20016). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 474-479(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Cross sections for 180° inelastic electron scattering from the deuteron were measured from the break-up threshold to beyond the quasielastic peak for incident beam energies between 0.7 and 1.3 GeV, corresponding to 0.75≦Q^2≦2.75 (GeV/c)^2. The data are in reasonable agreement with nonrelativistic models that include final-state interactions are meson exchange currents.

23574 Measurement of two-body deuteron photodisintegration at high photon energies and θ/sub cm/ = 90°. Napolitano, J.; Freedman, S.J.; Geesaman, D.F.; Gilman, R.; Green, M.C.; Holt, R.J.; Jackson, H.E.; Kowalczyk, R.; Marchand, C.; Nelson, J.; and others. (Argonne National Laboratory, Argonne, IL 60439--4843). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 480-485(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We report preliminary results from a measurement of the process ^{2}H(γ,p)n at θ/sub CM/ = 90° and for photon energies between 0.8 and 1.6 GeV. The results are compared to a conventional calculation based on meson-exchange and to models based on subnucleonic degrees of freedom. We find strong disagreement with the meson-exchange calculation, and best agreement with simple constituent counting at the highest energies.

23575 Quasi-elastic electron scattering from ^{3}H and ^{3}He. Dow, K.A. (Bates Linear Accelerator Center Massachusetts Institute of Technology, Middleton, MA 01949 and The Bates Tritium Collaboration). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 521-526(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Inelastic electron scattering cross sections of ^{3}H and ^{3}He have been measured at the MIT-Bates Linear Accelerator Center, at incident energies from 65 to 790 MeV, and two scattering angles. Longitudinal and transverse response functions have been extracted for 3-momentum transfers between 200 and 550 MeV/c. These response functions are compared for the two nuclei, and the single-particle nature of the quasi-elastic process can be seen. The response functions also are compared with theoretical calculations. The Coulomb sum rule is formed for both nuclei; the results agree

with an exact theoretical calculation. Indications of saturation and two-proton correlations in the initial state are seen.

23576 **Radiative kaon capture.** McIntyre, E.K.; Booth, E.C.; Fickinger, W.; Gall, K.P.; Hasinoff, M.D.; Hessey, N.P.; Horvath, D.; Lowe, J.; Measday, D.F.; Miller, J.P.; and others. (Boston University, Boston, MA, USA 02215). *AIP (American Institute of Physics) Conference Proceedings;* 176: No. 1, 673-676(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Negative kaons were stopped in liquid hydrogen and liquid deuterium targets to study radiative capture rates. Branching ratios for the radiative kaon capture reactions $K^-p \rightarrow \Lambda\gamma$ and $K^-p \rightarrow \Sigma^0\gamma$ provide information about the quark structure of the $\Lambda(1405)$. In the reaction $K^-d \rightarrow \Lambda n\gamma$, the shape of the photon spectrum in the endpoint region provides information on the final state Λ-n interaction. Superior photon resolution is needed to distinguish the signal photons from the background of π^0 decay photons. Such resolution is provided by the B.U. NaI detector, which has a resolution of 1.3% (FWHM) near 300 MeV. A description of the experimental technique and data reduction is presented, along with preliminary branching ratio results.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

23577 **(CONF-880399—7) Nucleus-nucleus collisions at ultrarelativistic energies.** Gustafsson, H.A.; Kampert, K.H.; Albrecht, R.; Awes, T.C.; Baktash, C.; Beckmann, P.; Berger, F.; Bock, R.; Claesson, G.; Clewing, G. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009624/JAW.

From 23. Rencontre de Moriond: current issues in hadron physics; Les Arcs, France (13 Mar 1988).

Results are presented from 60 and 200 AGeV p, ^{16}O and ^{32}S projectiles with C, Cu, Ag and Au nuclei. Energy spectra are measured at zero degrees and transverse energy distributions in the pseudorapidity range from 2.4 to 5.5 are shown. The average transverse energy per participant is found to be almost independent of projectile-target mass. Transverse momentum distributions of inclusive photons and neutral pions at midrapidity were in addition measured with lead glass array. For all target projectile combinations an increase in average p/sub T/ is observed for small values of entropy, which is deduced from the central multiplicity density. Different from proton induced reactions 200 AGeV ^{16}O + Au data show a plateau like region at large values of entropy density. 17 refs., 5 figs.

23578 **(CRN-PN—8804) Two proton stripping reactions induced by 480 MeV/sup 12/C on 1p and 2s-1d shell nuclei.** Boucenna, A.; Kraus, L.; Linck, I. and others. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires; Strasbourg-1 Univ., 67 (France)). 1988. 17p. (CONF-880195—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757196/JAW.

From 26. international winter meeting on nuclear physics; Bormio, Italy (25 Jan 1988).

Two proton stripping reactions (C12, Be10) induced by 480 MeV C12 on J=0/sup +/ 1p and 2s-1d shell target nuclei C12, 016, Si28, and Ca40, were investigated at GANIL. Obtained spectra show that at this incident energy only a few final states are populated. This selectivity is due to the large angular orbital momentum mismatch between the grazing waves in the entrance and exit channels favoring large transfer of angular momentum; and the large Os cluster spectroscopic factors expected theoretically for final high spin states with stretched configurations. These reactions show similar features to two neutron transfer reactions (α, He2) performed on the same targets. Several states strongly excited in the proton reactions are the analog levels of those excited by the neutron transfers. These states have simple configurations and their positions are well predicted by simple shell model calculations, thus allowing spin propositions for unassigned levels. They also yield experimental estimates of the two-body matrix elements describing the interaction between nucleons. An estimation of the Coulomb interaction is obtained from a comparison of experimental and theoretical results for two proton and two neutron transfer reactions.

23579 (JINR—N-2-28-88, pp 5-12) **Cumulative proton polarization in p+/sup 12/C->p/sub c/(of 158 degree) + x reaction for incident protons in 17 to 62 GeV energy region.** Belyaev, I.M.; Vlasov, N.V.; Gavrishchuk, O.P.; Zolin, L.S.; Peresedov, V.F.; Shalygin, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780079/JAW.

In JINR rapid communications. Collection.

Cumulative proton polarization is measured under 159 l.s. angle for interactions of incident protons with carbon nuclei in the energy region from 17 to 62 GeV. Measurements are made for cumulative proton momenta from 510 to 840 MeV/c. Averaged over momentum polarization is not more than 10%, dependence on incident proton energy is weak. 13 refs.; 9 figs.

23580 **(JINR-E—1-88-250) Measurement of the tensor analyzing power for the /sup 12/C(d,p) reaction at P/sub d/ =9.1 GeV/c and zero angle proton emission.** Ableev, V.G.; Dzhmukhadze, S.V.; Fedukov, S.V. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. 7p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706223/JAW.

Submitted to the journal Zh. Ehksp. Teor. Fiz.

The tensor analyzing power T/sub 20/ of the fragmentation reaction /sup 12/C(d, p) has been measured at zero angle proton emission in a momentum range of $0 \leqq q \leqq 0.4$ GeV/c. The obtained T/sub 20/-dependence is compared with the analyzing power behaviour extracted from some theoretical models. 13 refs.; 2 figs.

23581 **(JINR-R—1-88-154) Dependence of the characteristics of proton-nuclear interactions at 4.2 and 10 GeV/c on a leading-particle energy.** Agakishiev, G.N.; Armutlijski, D.; Erofeeva, I.N. and others. (AN Azerbajdzhanskoj SSR, Baku. Inst. Fiziki; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706239/JAW.

Submitted to the journal Yad. Fiz. .

The characteristics of secondary protons and π/sup -/ mesons have been investigated in interactions of protons with carbon nuclei at 4.2 Gev/c and with carbon and tantalum nuclei at 10 GeV/c depending on the energy of leading protons. The spectra of leading protons are presented. The characteristics of events with the leading proton and leading neutron are compared. The specific energy losses of the leading nucleon in nuclear matter have been estimated. 16 refs.; 5 figs.; 5 tabs.

23582 **(JINR-R—1-88-226) π/sup 0/-meson spectra in CTa- and multinucleon CC-interactions at 4.2 GeV/c per nucleon.** Gulkanyan, G.P.; Korchagin, S.A.; Kanarek, T.; Kladnitskaya, E.N. (Erevanskij Fizicheskij Inst. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706241/JAW.

Submitted to the journal Yad. Fiz. .

The paper is devoted to the reconstruction and analysis of distributions over total energy as well as over transverse and longitudinal momenta in the c.m.s. obtained on the basis of corresponding distributions of γ-quanta for CTA and multinucleon CC interactions at 4.2 GeV/c. The reconstructed distributions of π/sup 0/-mesons are compared with the spectra of π-mesons obtained experimentally for the same types of interactions. 12 refs.; 6 figs.; 2 tabs.

23583 (KEK—88-6, pp 54-75) **/sup 16/O and /sup 32/S+/sup 207/Pb interactions in the CERN EMU-05 experiment.** Iyono, A.; Dake, S.; Tominaga, T. and others. (Okayama Univ. of Science (Japan)). Sep 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE89780072/JAW. (CONF-8802137—).

From Workshop on physics of quark-gluon-plasma; Tsukuba, Japan (18 Feb 1988).

Emission angles, momenta and charge-signs of all charged particles in forward hemisphere have been measured in /sup 16/O + Pb and /sup 32/S + Pb interactions at incident energy of 200 GeV per nucleon. The multiplicity distributions of /sup 16/O and /sup 32/S nucleus interactions are almost scaling expressed as a function of scaling variable Z(ident to Ns/<Ns>). The ratio of average pseudorapidity density of /sup 16/O + Pb to that of proton(200 GeV/c) + Pb is flat almost all over the range of eta ident to -ln tan (θ/2). Measuring momentum of central-forward charged particles for high multiplicity events, we have obtained their transverse momentum(P/sub T/) distributions as preliminary results.

23584 **(LA-UR—89-437) Measurement of the exclusive reaction ν/sub e/ + ^{12}C → e/sup {minus}/ + ^{12}N(g.s.).** Allen, R.C.; Bharadwaj, V.; Brooks, G.A.; Chen, H.H.; Doe, P.J.; Hausammann, R.; Lee, W.P.; Lu, X.Q.; Mahler, H.J.; Potter, M.E. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 3p. (CONF-8808145—30). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007761/JAW.

From Meeting of the Division of Particles and Fields of the American Physical Society (APS); Storrs, CT, USA (15 Aug 1988).

We have measured the cross-section for the exclusive reaction, ^{12}C(ν/sub e/,e/sup {minus}/)^{12}N(g.s.). The experiment was performed with a 15 ton fine-grained tracking detector exposed to ν/sub e/'s with equivalent energy of 37 MeV. The detector was triggered by single electrons and the exclusive inverse-beta reaction identified by the delayed coincidence of the ^{12}N(gs) positron-decay. The flux averaged cross-section was measured to be [1.18 +- 0.11(stat) +- 0.13(sys)] {times} 10/sup {minus}41/ cm^2. This result is compared to recent calculations. 3 refs., 1 fig.

23585 **/sup 14/N(n,p)/sup 14/C cross section from 61 meV to 34.6 keV and its astrophysical implications.** Koehler, P.E.; O'Brien, H.A. (Physics Division, Group P-3, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 4, 1655-1657(Apr 1989).

We have measured the /sup 14/N(n,p)/sup 14/C cross section from 61 meV to 34.6 keV. Our data are in agreement with previous measurements made via the inverse reaction, but are approximately a factor of 2.5 larger than a recent direct measurement. As a result, our data support the astrophysical reaction rate used in most previous nucleosynthesis calculations over the recently recommended three-fold reduction in this rate. Astrophysical implications of our new measurements are discussed.

23586 **Associated production of hypernuclei with (πi,K$^+$) reaction.** Peng, J.C. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 39-53(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Status of associated production of hypernuclei is discussed. Recent (π^+,K$^+$) results from AGS to study the spectroscopy of Λ single particle states in heavy systems are presented.

23587 **Measurement of /sup 16/O(γ,n$_0$) at medium energies.** Beise, E.J.; Dodson, G.W.; Garcon, M.; Hoeibra-circleten, S.; Maher, C.; Pham, L.D.; Redwine, R.P.; Sapp, W.; Wilson, K.; Wood, S.A.; and others. (Massachusetts Institute of Technology Cambridge, MA 02139). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 534-536(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Exclusive differential (γ,n) cross-sections on /sup 16/O have been measured at E/sub γ/ = 150, 200 and 250 MeV for θ/sub L/ = 50^0, 60^0 and 90^0. This measurement is the first of its type to be reported for the energy region above the pion production threshold. Calculations of the (γ,n) reaction indicate that large effects are expected from meson exchange currents. The (γ,n) data will be compared with the predictions of such calculations and with available (γ,p) data.

23588 **Progress report on the Bates parity experiment.** Souder, P.A.; Kim, D.h.; Kumar, K.S.; Schulze, M.E.; Lubell, M.S.; Patch, J.S.; Wilson, R.; Dodson, G.W.; Dow, K.A.; Farkhondeh, M.; and others. (Syracuse University, Syracuse, NY 13210). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 543-549(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We are performing an experiment at the MIT Bates Linear Accelerator Center to measure the parity-violating asymmetry in the elastic scattering of polarized electrons from carbon. The asymmetry, which is due to the isoscalar piece of the neutral weak current, is predicted to be about one part per million for our experimental conditions. We have recently obtained preliminary data with polarized electrons. This paper discusses the status of the experiment, with emphasis on our understanding of the most important systematic errors.

23589 **Threshold behavior of direct electron production in proton-beryllium collisions.** Naudet, C.; Krebs, G.F.; Lallier, E.; Letessier-Selvon, A.; Matis, H.S.; Roche, G.; Schroeder, L.; Seidl, P.; Yegneswaren, A.; Wang, Z.F.; and others. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 574-580(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We report measurements of direct electron pair production in p-Be interactions at 1.0, 2.1 and 4.9 GeV kinetic beam energies. The invariant mass and p/sub t/ spectra along with the total cross sections are presented. A rapid decrease in the total cross section is observed at the lowest energy.

23590 **Probing two-nucleon correlations with pion double-charge exchange.** Bear, H.W. (Los Alamos National Laboratory, Los Alamos, NM 87545, USA). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 589-600(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

A review is given of pion double-charge reactions at incident energies of 30 to 65 MeV and leading to isobaric-analog states. The large effects on cross section magnitudes and angular-distribution shapes produced by two-nucleon correlations are discussed. New results on 1 f/sub 7/2/ shell nuclei are compared to predictions of a shell-model-based two-amplitude model.

23591 **Coincidence measurements of pion single charge exchange in the Δ-resonance region.** Hoeibra-circleten, S.; Gilad, S.; Burger, W.J.; Dodson, G.W.; Gatoff, G.; Pham, L.D.; Redwine, R.P.; Piasetzky, E.; Baer, H.W.; Bowman, J.D.; and others. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 614-619(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We discuss the first coincidence measurements of the reaction (π^+,π^0p). The were performed primarily on /sup 16/O at T/ sub π//sub =/ = 165 and 245 MeV. The reaction is shown to have a clear quasi-free signature. The π^0 energy spectra for events corresponding to removal of a p-shell nucleon are compared to predictions of Δ-hole model calculations; the calculation generally underestimate the (π^+, π^0p) cross sections. At forward pion angles experimental ratios between the (π^+, π^+p) and (π^+, π^0p) reactions are found to differ significantly from estimates using free π-N cross sections. A study of the A-dependence of the (π^+, π^0p) process indicate that the cross section is roughly constant over the examined range of nuclear masses.

23592 **A-dependenc of psi production in πp nucleus collisions at 530 GeV/c.** Marshall, T.; Bowyer, T.; Crittenden, R.; Dzierba, A.; Kartik, S.; Martin, J.; Neyman, C.; Smith, P.; Sulanke, T.; Welch, K.; and others. (Indiana University, Bloomington, IN 47405). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 624-629(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The E672/E706 Spectrometer, located in the MW beam at Fermilab, was used to collect data on events containing a pair of muons in the final state with large effective mass. The momentum of incident pions and protons was 530 GeV/c. Nuclear targets included Be, C, Al, Cu and Pb. We report on a preliminary measurement of the A-dependence of the per nucleus cross section for forward J/psi production. The apparatus also detected charged particles and γ's produced in association with the muon pair. The expected physics results on the hadroproduction of chi states and beauty particles are discussed.

23593 **Intranuclear cascade study of the hadron-nucleus interactions at 1 GeV/c.** Divadeenam, M.; Ward, T.E. (Neutral Beam Division, Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 691-700(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The proton inclusive spectra measured with 800 MeV/c π^+ beam (BNL) on light nuclei, and the 600 MeV/c p-bar beam (LEAR) on ^{6}Li and ^{63}Cu have been successfully interpreted in terms of the Intranuclear Cascade (INC) Model. According to the INC model predictions the p-bar induced reaction results in high pion yield for the light ^{6}Li target case. This is attributed to the nonavailability of nucleons to be knocked out by the pions produced following the p-bar annihilation. While in the case of the heavier ^{63}Cu target some of the internally produced pions are subsequently absorbed leading to thermal equilibration of the nuclear medium, resulting in a softer proton spectrum at the high energy end. Based on the INC model predictions the K^+ induced reactions could be studied to search for the "true resonances" beyond 1 GeV K^+ energy.

23594 **Search for bound states of the eta-meson in light nuclei.** Pile, P.H. (Brookhaven National Laboratory, Upton, New York, 11973). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 719-724(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

This paper describes an experiment designed to search for a new form of nuclear matter: a bound eta-nucleus system. The (π^+,p) reaction was used to study the possible formation of an eta-mesic nucleus. No narrow eta-nuclear bound states were observed using Li, ^{12}C, ^{16}O and ^{27}Al targets. The results of this experiment have now been published elsewhere by Chrien et al.

23595 **Understanding the nuclear spin resonance to intermediate energy protons.** Glashausser, C. (Physics Department, Rutgers University, Piscataway, NJ 08854). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 811-818(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Measurements of the spin-flip probability S/sub n//sub n/ for inclusive inelastic proton scattering around 300 MeV determine the relative ΔS = 1/(ΔS = 0+ΔS = 1) response of the nucleus provided S/sub n//sub n/ is a "robust" observable. Recent data then give a general picture of the nuclear spin response up to about 40 MeV of excitation for momentum transfers up to about 200 MeV/c. Slab model calculations give qualitative agreement with much of the data; they explain the small values at high excitation. They do not explain the values approaching 90% for intermediate momentum transfers. RPA calculations which localize the S = 0 strength at lower excitation energies, coupled with a shift in S = 1 strength to higher excitations.

23596 **Analysis of the exclusive interaction ν/sub μ/ $^{-12}$C→μ^{-12} N near threshold.** Bowles, T.; Brown, A.; Brown, R.E.; Burman, R.; Clark, D.; Clearwater, S.; Dombeck, T.; Kruse, H.; Lee, D.; Auerbach, L.; and others. (Los Alamos National Laboratory, Los Alamos, NM). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 912-917(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We report on the first observation of ν/sub μ/-induced nuclear transitions ν/sub ν/^{12}C→μ^{-12}N. From a sample of ν/sub μ/ interactions on carbon near the muon production threshold, events with a ^{12}N nucleus in the final state were isolated by observing the subsequent beta decay of the ^{12}N ground state. This exclusive process represents (31+12)% of the inclusive cross section for ν/sub μ/ ^{12}C→μ^-X. (Theoretical estimates of this fraction suggest a maximum of only 3%.) The muon kinetic energy for both the inclusive and exclusive channels was also measured. Using the muon kinetic energy distribution we identify the contributions to the cross sections from the ^{12}N/sup */ and compare our results to theory.

23597 **Parity mixing of the O^+-O^-;T = 1 doublet in / sup 14/N.** Zeps, V.J.; Adelberger, E.G.; Garcia, A.; Gossett, C.A.; Swanson, H.E.; Haeberli, W.; Quin, P.A.; Sromicki, J. (University of Washington, Seattle WA 98195). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1098-1105(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We have examined parity mixing of the O^+,O^-; T = 1 doublet in /sup 14/N (E/sub chi/{similar←to}8.6 MeV) to study the isoscalar part of the weak nucleon-nucleon interaction. The weak matrix element connecting the two levels is extracted by measuring the longitudinal analyzing power (A/sub L/) in the elastic scattering cross-section across the narrow /sup 13/C+-arrow-rightpJ/sup π/ = 0^+ -resonance at E/sub p/ = 1.16 MeV.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

23598 **(CONF-890408—1) A re-evaluation of ^{32}S(n,p) cross sections from threshold to 5 MeV.** Fu, C.Y. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE88016347/JAW.

From Advances in nuclear engineering computation and radiation shielding; Santa Fe, NM, USA (9 Apr 1989).

Two evaluations of the ^{32}S(n,p) reaction cross sections, currently being used for the Nagasaki and Hiroshima dosimetry studies, yielded results that differ significantly. These two evaluations were reviewed and both were found to be quite old and without benefit of modern theoretical guidance and recent experimental

data, hence inadequate in view of its relative importance for the present application. The necessity for a re-evaluation is further enhanced by the fact that: the present data search has uncovered a relatively high-quality data set that was not known previously, a generalized Bayes-theorem code is now available for averaging the various data sets with uncertainties and generating uncertainties for the results, effects on data combination of differing energy resolution in the various measurements can now be accounted for, and the ENDF/B-VI standards for $^{235}U(n,f)$ cross sections have become available for renormalizing two of the available data sets. The re-evaluation is performed to 5 MeV, the upper energy limit for the present purpose. 8 refs., 2 figs.

23599 **(DOE/ER/40048—216-L8) The giant dipole resonance and the deformation of highly excited nuclei.** Snover, K.A. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1988. Contract AC06-81ER40048. 14p. (CONF-880639—8). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008215/JAW.

From International conference on contemporary topics in nuclear structure physics; Cocoyoc, Mexico (9 Jun 1988).

A great deal has been learned in the past few years about the shapes of highly excited nuclei through studies of the giant dipole resonance in heavy ion fusion-evaporation reactions. At bombarding energies ≦ 5-7 MeV per nucleon, statistical decay of the GDR dominates the γ-emission spectrum for Eγ = 5 - 30 MeV, and detailed spectrum shape analyses have been performed for many different reactions populating nuclei over most of the periodic table and corresponding to nuclear spins I = 0-50{h←bar} and temperatures T = 1-2 MeV. These temperatures span the interesting range from shell-dominated shapes to liquid-drop dominated shapes, and the interplay of these effects as a function of spin, temperature and nuclear species is expected to lead to a variety of nuclear shapes and shape changes. On the other hand, because nuclei consists of a small number of particles, shape fluctuations are very important, and tend to obscure the nuclear shapes expected in mean-field calculations. In this paper I focus on two objectives: A general assessment of our overall understanding of the properties of the GDR in highly excited nuclei and the scope and limitations of GDR spectrum shape analyses, and a discussion of the importance of angular distribution measurements and their implications in a specific case - oblate, rapidly rotating nuclei with mass A ~ 40. 20 refs., 3 figs.

23600 **Latest results on subthreshold kaons and antiprotons.** Igo, G. (University of California, Los Angeles, CA 90024). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1085-1089(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The bombarding energy dependence up to 1.2 GeV/A and the dependence of target-projectile of K^- production have been studied. In one case, K^+ production has been measured at the same Q-value as in K^- production. Preliminary results on antiproton production are reported.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

23601 (INIS-BR—1440, pp 4) **Measurement of cross section of the /sup 58/Ni (n,p) /sup 58/Co reaction induced by fast neutrons in the energy range from 8 to 14 MeV.** Suita, J.C.; Silva, A.G. da; Barros, S. de; Cabral, S.C.; Antunes, L.J.; Auler, L.T. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

23602 (INIS-BR—1440, pp 8) **Measurements of level density by (p,α) and (α,p) reactions.** Vinagre Filho, U.M.; Santos, W.M.S.; Brasil, V.B.; Costa, V.L. da; Gaspar, M.B.; Auler, L.T.; Barros, S.; Peterson, R.J.; Lind, D.; Silva, A.G. da. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

23603 **Fission barriers of light nuclei.** Grotowski, K.; Pldash-baraneta, R.; Blann, M.; Komoto, T. (Institute of Physics, Jagellonian University, Reymonta 4, Cracow, Poland). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 4, 1320-1325(Apr 1989).

Experimental fission excitation functions for compound nuclei /sup 52/Fe, /sup 49/Cr, /sup 46/V, and /sup 44/Ti formed in heavy-ion reactions are analyzed in the Hauser-Feshbach/Bohr-Wheeler formalism using fission barriers based on the rotating liquid drop model of Cohen et al. and on the rotating finite range model of Sierk. We conclude that the rotating finite range approach gives better reproduction of experimental fission yields, consistent with results found for heavier systems.

23604 **βi decay and cosmic-ray half-life of /sup 54/Mn.** Sur, B.; Vogel, K.R.; Norman, E.B.; Lesko, K.T.; Larimer, R.; Browne, E. (Nuclear Science Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 4, 1511-1513(Apr 1989).

/sup 54/Mn has previously been observed in cosmic rays where is it expected to decay by β^+ and β^- transitions with a half-life of a few million years. The present experiment to measure the β^+ decay branch in the laboratory establishes an upper limit of 4.4 x 10/sup -8/ for the branching ratio, and a lower limit of 13.3 for the logft value of this second forbidden unique transition. If it is assumed that the β^- decay branch has the same logft value, then its partial half-life must be greater than 4 x 10^4 years.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

23605 (INIS-BR—1440, pp 6) **Measurement of /sup 70/Ge (α,n) 73 Se reaction cross section.** Barreto, J.; Wolf, H.; Machado, V.; Vinagre Filho, U.M.; Costa, V.L. da; Merchant, A.C.; Carlson, B.V. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

23606 (INIS-BR—1440, pp 10) **Measurements of the /sup 59/Ni energy level density by /sup 59/Co (p,n) and /sup 56/Fe (α,n) reactions.** Suita, J.C.; Cabral, S.C.; Auler, L.T.; Silva, A.G. da. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

23607 **Status of selected neutrinoless ββ-decay experiments.** Avignone F.T. III; Brodzinski, R.L.; Reeves, J.H.; Miley, H.S. (Department of Physics and Astronomy, University of South Carolina, Columbia, South Carolina 29208). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 946-952(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

A brief update is given on a number of ongoing $O\nu\ \beta\beta$-decay experiments. Progress is reported in background reduction, limits are given on the various modes of decay, and projections of

potential sensitivity are made in some cases. In particular, a new result from the PNL-USC Ov $\beta\beta$ decay experiment yields a half-life of (3.2/sup +2.2//sub -1.2/) x 10/sup 21/ y (1σ) for decay with the emission of a majoron. While a positive result is still observed, it is now statistically less significant. A new recently deepmined Ge to decrease background cosmogenic radioactivity.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

23608 **(FEI—1921) Mean cross sections of fast neutrons radiative capture, transmission and mean resonance parameters for the tin isotopes.** Timokhov, V.M.; Bokhovko, M.V.; Kazakov, L.E.; Kononov, V.N.; Manturov, G.N.; Poletaev, E.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1988. 29p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706151/JAW.

Results of measurements of neutron radiative capture cross sections in the energy range of 20-450 keV and of neutron transmission in the energy range of 20-1400 keV for /sup 112,114,115,116,117,118,119,120,122/ /sup ,124S/n isotopes and natural mixture of tin are presented. Analysis of the experimental data in the framework of nuclear reactions statistical theory is carried out, as a result of which data on neutron and radiation strength functions, potential scattering radii for S- and P-neutrons, as well as nuclear levels density parameters, are obtained. 24 refs.; 7 figs.; 8 tabs.

23609 **(IAE—4544/2) Investigation of γ radiation of /sup 111/Cd and /sup 113/Cd from the (n,n'γ) and (n-bar/sub res/ , γ) reactions.** Baskova, K.A.; Vovk, A.B.; Gerus, G.M.; Govor, L.I.; Demidov, A.M.; Kurkin, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 48p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706153/JAW.

Γ-spectra, angular distributions and linear polarization of γ-quanta from the /sup 111,113/Cd(n, n'γ) reactions, as well as γ-spectra from /sup 110,112/Cd(n-bar/sub res/'γ)/sup 111,113/Cd are measured. Diagrams for /sup 111,113/Cd levels and γ-transitions are plotted. Multipole mixtures in γ-transitions are determined. 6 refs.; 6 figs.; 13 tabs.

23610 **(INDC(PAK)—007/GI) Induced radioactivities and cross section measurements of the 14 MeV irradiated molybdenum foils.** Gul, K.; Ahmad, M.; Anwar, M.; Saleem, S.M.; Awan, B.A. (Pakistan Inst. of Nuclear Science and Technology, Islamabad (Pakistan)). (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Dec 1988. 12p. (INT—88/2). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705727/JAW.

The radioactivities of 14 MeV neutron irradiated Molybdenum foils have been measured for comparison exercise conducted by the IAEA Nuclear Data Section. The spectra of the characteristic gamma-rays emitted as a result of the induced radioactivity were taken with a Ge(Li) detector and an Intrinsic Germanium detector. The cross sections for the reaction /sup 92/Mo(n,np)/sup 91m/Nb, /sup 95/Mo(n,p)/sup 95/Nb and /sup 98/Mo(n,α)/sup 95/Zr have been determined using the information provided by the IAEA on the irradiation time, total fluence and masses of the irradiated foils. The activation cross sections determined from the present measurements have been compared with previous work. (author). 8 refs, figs, 3 tabs.

23611 **(JINR-R—15-88-186) Study on the /sup 123/Te(n,α) reaction at 24.5 keV neutron energy.** Vtyurin, V.A.; Chadraabal, I.; Grebnev, A.V.; Pshenichnyj, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1988. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706263/JAW.

Alpha spectra from the /sup 123/Te(n,α)/sup 120/Sn reaction were measured at neutron energy of 24.5 keV achieved by neutron transmission through a /sup 56/Fe filter. Averaged cross sections were obtained to be 2.8-0.7 μb. In accordance with the assumptions of the statistical theory an average α-width of s-wave neutron resonance was obtained to be 3.2+-0.8 μev. The results were compared with the data acquired for neutron energies below 2.5 keV. A mean weighted value for the /sup 123/Te α-width has been refined and then used for deriving a new value for the radiation strength function of primary γ-transitions obtained to be S/sub γ/(E1)=(65+-30) MeV/sup -3/ or S/sub γ/(M1)=(27+-13) MeV/sup -3/ from the data on (n, $\gamma\alpha$) reaction. 16 refs.; 2 figs.; 3 tabs.

23612 **Single-particle and multiparticle analysis of nucleus-nucleus collisions at 14.6, 60, and 200 GeV/nucleon.** von Gersdorff, H.; Amundson, J.; Freier, P.S.; Kapusta, J.; Waddington, C.J.; Barbier, L.M.; Jones, W.V.; Moon, K.H.; Park, I.G.; Pruet, O.E.; and others. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 4, 1385-1394(Apr 1989).

The angles of all charged secondaries have been measured in central collisions of /sup 16/O with AgBr at 14.6, 60, and 200 GeV per nucleon. The pseudorapidity distributions are approximately Gaussian in shape. The widths increase monotonically with beam energy, but are essentially independent of multiplicity at a fixed beam energy. Quantitatively, the widths are consistent with Landau's hydrodynamical model and inconsistent with a spherical fireball model and with Bjorken's hydrodynamical scaling model. There are no statistically significant correlations in the azimuthal angle of the observed charged secondaries. Analysis of the two-particle pseudorapidity correlation functions and of the pseudorapidity gap distributions provide no evidence of significant cluster production. The data are consistent with a Monte Carlo simulation based on independent emission of the secondary particles, although intrinsic few-particle correlations could be hidden by the high multiplicities in these events.

23613 **Superdeformation in the odd-odd nucleus /sup 150/Tb: Experimental search for superdeformed configurations.** Deleplanque, M.A.; Beausang, C.W.; Burde, J.; Diamond, R.M.; Stephens, F.S.; McDonald, R.J.; Draper, J.E. (Nuclear Science Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 4, 1651-1654(Apr 1989).

A superdeformed band was found in the nucleus /sup 150/Tb following the reaction /sup 31/P+/sup 124/Sn at 160 MeV. This is the first odd-odd nucleus in the mass 150 region where such a band has been found. Its observed properties do not differ significantly from those of other cases in this mass region. From a systematic study of this region, we have determined experimentally the contribution to the moment of inertia scrI/sup (2)/ in each of the last particles ion these nuclei. At present, this seems to us the best way to identify the orbitals occupied by these particles.

23614 **Level structure of odd-mass Pr isotopes: Decay of 3.0-min /sup 145/Ce to levels of /sup 145/Pr.** Baum, E.M.; Robertson, J.D.; Mantica P.F. Jr.; Faller, S.H.; Stone, C.A.; Walters, W.B.; Meyer, R.A.; Kusnezov, D.F. (Department of Chemistry, University of Maryland, College Park, Maryland 20742). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 4, 1514-1527(Apr 1989).

The structure of /sup 145/Pr has been investigated by measuring the gamma-ray singles, gamma-ray coincidence, and gamma-ray angular correlation spectra, along with conversion-electron singles spectra for the decay of 3.0-min /sup 145/Ce to levels of /sup 145/Pr. A level scheme is proposed that includes a number of new levels as well as new spin and parity assignments for several levels. The conversion-coefficient measurements establish the presence of a low-energy ($3/2^-$) level at 787 keV whose strong population in beta decay confirms negative parity for the ground state of /sup 145/Ce. Interacting boson-fermion model calculations for /sup 143/Pr and /sup 145/Pr are found to be in reasonable agreement with the observed low-energy positive-parity levels, while the presence

of the low-energy (3/2$^-$) level suggests the coexistence of more deformed configurations.

23615 **Comparison of nuclear transport models with 800A-MeV La + La data.** Aichelin, J.; Cugnon, J.; Fraenkel, Z.; Frankel, K.; Gale, C.; Gyulassy, M.; Keane, D.; Ko, C.M.; Randrup, J.; Rosenhauer, A.; and others. (Institut fuer Theoretische Physik, Universitaet Heidelberg, D-6900 Heidelberg, Federal Republic of Germany). *Physical Review Letters;* **62**: No. 13, 1461-1464(27 Mar 1989).

Nuclear transport models including density- and momentum-dependent mean-field effects are compared to intranuclear-cascade models and tested on recent data on inclusive p-like cross sections for 800A-MeV La+La. We find a remarkable agreement between most model calculations but a systematic disagreement with the measured yield at 20^0, possibly indicating a need for modification of nuclear transport properties at high densities.

23616 **Fragmentation products with nonstatistical excited-state populations.** Nayak, T.K.; Murakami, T.; Lynch, W.G.; Swartz, K.; Fields, D.J.; Gelbke, C.K.; Kim, Y.D.; Pochodzalla, J.; Tsang, M.B.; Xu, H.M.; and others. (National Superconducting Cyclotron Laboratory and Department of Physics Astronomy, Michigan State University, East Lansing, Michigan 48824). *Physical Review Letters;* **62**: No. 9, 1021-1024(27 Feb 1989).

Relative populations of particle-unbound states were measured for /sup 10/B nuclei emitted behind the grazing angle for the /sup 14/N+/sup nat/Ag reaction at E/A = 35 MeV. The populations of states decaying by proton and α-particle emission are inconsistent with purely statistical distributions, indicating that the intrinsic degrees of freedom of the fragmenting system may not be fully equilibrated at the instant the fragment separates from the rest of the system.

23617 **Characteristics of hardron-nucleus interactions at 100 GeV/c.** Toothacker, W.S.; Whitmore, J.; Elcombe, P.A.; Hill, J.C.; Neale, W.W.; Kowald, W.; Walker, W.D.; Lucas, P.; Voyvodic, L.; Ammar, R.; and others. (The Pennsylvania State University, Mont Alto, Pennsylvania 17237). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 642-647(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We report on 100 GeV/c interactions of p and p-bar with Ag and Au targets. This is a subset of the data from Fermilab experiment E597 and was performed with the 30-inch bubble chamber and Downstream Particle Identifier. Final state protons with laboratory momentum less than 1.4 GeV/c have been identified by their ionization in the bubble chamber. Final state protons/antiprotons with laboratory momentum greater than 10 GeV/c have been identified using CRISIS, an ionization sampling drift chamber. The cross section and mean transverse momentum squared of the leading baryon from the reactions p+(Ag,Au)→p+X and p-bar+(Ag,Au)→p-bar+X are presented as a function of the rapidity loss of the leading baryon. The laboratory rapidity and transverse momentum squared of the associated pions are also presented.

23618 **Pseudorapidity distributions and correlations in central /sup 16/O interactions at 200 A GeV.** Adomovich, M.I.; Alexandrov, Y.A.; Asimov, S.A.; Badyal, S.K.; Bhalla, K.B.; Bharti, A.; Bhasin, A.; Burnett, T.H.; Cai, X.; Chernova, L.P.; and others. (Lebedev Institute of Physics). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1047-1052(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Here we present results on charged hadron production in an experiment using tracking detectors with the highest possible spatial resolution: emulsion chambers. A sample of the most central collisions will be compared to the predictions of the Lund Model, which does an accurate job of representing conventional (non-quark-gluon plasma) physics in nuclear reactions. We can use the high resolution of our detectors to examine spatial correlations in several ways. In particular, the radial size of the particle formation region can be estimated using pion interferometry techniques. (AIP)

6518 Nuclear Properties And Reactions, A=150-189, Experimental

23619 **Nuclear data sheets for A = 158.** Lee, M.A. (Idaho National Engineering Laboratory, EG&G Idaho, Inc., Idaho Falls, Idaho 83415 USA). *Nuclear Data Sheets;* **56**: No. 2, 199-312(Feb 1989).

The experimental results from the various reaction and decay studies leading to nuclides in the A = 158 mass chain, and α decays from it, have been reviewed. These data are summarized and presented, together with adopted level schemes and properties. copyright 1989 Academic Press, Inc.

23620 **Nuclear data sheets for A = 163.** Burrows, T.W. (National Nuclear Data Center, Brookhaven National Laboratory, Upton, NY 11973 USA). *Nuclear Data Sheets;* **56**: No. 2, 313-443(Feb 1989).

The 1980 evaluation of A = 163 (80Da03) has been revised using experimental decay and reaction data received by October 30, 1988. copyright 1989 Academic Press, Inc.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

23621 **(CEA-CONF—9527) Charged pion emission and collective flow effects in 800 A MEV Ne-nucleus collisions.** Poitou, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). 1988. 5p. (CONF-880161—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757177/JAW.

From 16. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (18 Jan 1988).

Charged pion emission in relativistic Ne-nucleus collisions has been investigated with the large solid angle detector Diogene. The π/sup +-/ multiplicities are overestimated by Intra-Nuclear Cascade (INC) calculations, especially at small impact parameter. The difference between the π/sup +/ and π/sup -/ momentum spectra may arise from Coulomb effects. The π/sup +-/ flow has been studied in the reaction plane determined with the baryons. The average pion transverse momentum in the reaction plane, always poitive, is larger for π/sup +/ than π/sup -/. The pion flow is maximum with heavy targets and compatible with zero for the symmetric system Ne + NaF. Contrary to these results, the INC give always zero flow.

23622 (INIS-BR—1441, pp 45-63) **Study of the nuclear photoexcitation mechanisms in the Δ (3,3).** Arruda Neto, J.D.T. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). 1986. (In Portuguese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

Experimental results and conclusions obtained for the /sup 209/Bi electro - and photofission in a energy range between the fission barrier ({similar←to} MeV) and the neighbourhood of the Δ peak are presented. (L.C.).

23623 **(INS—717) Isomeric transitions of /sup 211m/Po and /sup 212m/Po and E4 effective charge.** Kudo, H.; Nomura, T.; Sueki, K.; Magara, M.; Yoshida, N. (Niigata Univ. (Japan). Faculty of Science). (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Nov 1988. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757231/JAW.

The branching ratios of isomeric transitions from high-spin α-decaying isomers in /sup 211/Po and /sup 212/Po have been measured for the first time to be 0.016 +- 0.004 % and 0.07 +- 0.02 %, respectively. The result gives the first clear experimental evidence for that the isomeric transition in /sup 211m/Po takes place via E4 with an effective charge of about 1.8 e, confirming J/

sup π/ = 25/2/sup +/ assignment for /sup 211m/Po. The E4 character of the isomeric transition in /sup 212m/Po has also been confirmed.

23624 **(JINR-E—1-88-245) Nuclear reactions of medium and heavy target nuclei with high-energy projectiles. Fragmentation of /sup 197/Au by 3.65 AGeV /sup 12/C-ions and 3.65 GeV protons.** Kozma, P.; Damdinsuren, C. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. 14p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705787/JAW.

Submitted to Czech. J. Phys., B.

The cross sections of a number of target fragmentation products formed in nuclear reactions of 3.65 AGeV /sup 12/C-ions and 3.65 GeV protons with /sup 197/Au have been measured. The measurements have been done by direct counting of irradiated targets with Ge(Li) gamma-spectrometers. Comparison between these and other data has been used to test the hypotheses of factorization and limiting fragmentation. The total cross section for residue production in both reactions indicates that target residues are formed mainly in central collisions. 15 refs.; 5 figs.; 4 tabs.

23625 **(JINR-R—1-88-294) Generation of neutrons in a lead target by protons, deuterons, alpha-particles with 4.5 GeV/c per nucleon momentum.** Voronko, V.A.; Kostin, V.Ya.; Migalenya, V.Ya.; Sidorenko, V.V.; D'yachenko, V.M.; Nikityuk, N.M.; Tolstov, K.D. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.; Moskovskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706243/JAW.

Submitted to the journal At. Ehnerg. .

The results of the experiments performed at the synchrophasotron on neutron generation in a lead target of 50x50x80 cm size irradiated with protons, deuterons and alpha particles with 4.5 GeV/c per nucleon momentum are presented. Neutrons were registered by detectors of n, F and n, γ reactions installed in a target volume. 4 refs.; 2 figs.; 2 tabs.

23626 **Heavy-ion excitation and photon decay of giant resonances in /sup 208/Pb.** Beene, J.R.; Bertrand, F.E.; Halbert, M.L.; Auble, R.L.; Hensley, D.C.; Horen, D.J.; Robinson, R.L.; Sayer, R.O.; Sjoreen, T.P. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 4, 1307-1319(Apr 1989).

We have determined the ground-state photon decay probability and the branching ratios to a number of low-lying states as a function of excitation energy in /sup 208/Pb up to {similar←to}15 MeV. Results for the giant quadrupole resonance at 10.6 MeV include determination of a ground-state electromagnetic transition strength B(E2)up-arrow = 5800 +- 1600 e^2fm^4 and observation of strong suppression of the E1 transition from the resonance to the 3^- state at 2.6 MeV. These results confirm the common assumption of the predominately isoscalar character of the 10.6-MeV resonance. Ground-state gamma coincidences enable us to isolate the isovector giant dipole resonance, which is too weak to be seen in singles, and to test models for its excitation in heavy-ion scattering.

23627 **Dirac optical potentials for nucleon scattering by /sup 208/Pb at intermediate energies.** Kozack, R.; Madland, D.G. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 4, 1461-1474(Apr 1989).

We perform a global analysis of intermediate energy nucleon plus /sup 208/Pb scattering data using the Dirac phenomenology. Proton elastic differential cross sections, analyzing powers, spin rotation functions, and total reaction cross sections, together with neutron total cross sections, spanning an incident energy range of 80--800 MeV, are used in the determination of a Dirac scalar-vector global potential. Two of six energy dependencies studied are selected to construct best-fit nucleon-nucleus potentials for the reduced incident-energy interval of 95--300 MeV. These potentials reproduce the experimental data uniformly within the reduced energy interval. Explicit values for the isovector strengths of the nucleon-nucleus potential are given. The correlations and ambiguities among the parameters of the potentials are studied. Predictions are made for the elastic differential cross section and spin observables for neutron plus /sup 208/Pb scattering.

23628 **Quasielastic scattering of /sup 30/Si on /sup 208/Pb and the quadrupole moments of 2^+ levels in /sup 30/Si.** Vojtech, R.J.; Kolata, J.J.; Lewandowski, L.A.; Rehm, K.E.; Kovar, D.G.; Stephans, G.S.F.; Vineyard, M.F. (Physics Department, University of Notre Dame, Notre Dame, Indiana 46556). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 4, 1377-1384(Apr 1989).

Quasielastic yields are reported for the /sup 30/Si+/sup 208/Pb reaction at E/sub lab/(/sup 30/Si) = 222 MeV. Coupled-channels analysis of the elastic and inelastic scattering results in an excellent description of the experimental data. The static quadrupole moments of the first two 2^+ states in /sup 30/Si are measured to be -9 +- 4 efm^2 and -4 +- 9 e fm^2, respectively. The sign of the interference term for the transition between these two states is unambiguously determined to be negative, corresponding to destructive interference. Few-nucleon-transfer reaction data are also presented. Quasielastic processes account for 25% of the total reaction cross section.

23629 **Study of high energy nucleus nucleus collisions.** Franz, A. (LBL, for the WA80-Collaboration, GSI-LBL-LUND-ORNL-MU-dieresisNSTER). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1026-1029(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The CERN experiment WA80 studies ultrarelativistic heavy ion collisions by calorimetry and charged particle measurements over a large fraction of 4π. Here I want to concentrate on a closer study of nucleus nucleus collisions and recent results from the lead glass spectrometer Saphir. (AIP)

23630 **Spectrometer results from BNL E802.** Abbott, T.; Akiba, Y.; Alburger, D.; Beavis, D.; Betts, R.R.; Birstein, L.; Bloomer, M.A.; Bond, P.D.; Chasman, C.; Chu, Y.Y.; and others. (Presented on behalf of the E-802 Collaboration by: Robert J. Ledoux). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1060-1067(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Measurements of collisions of 14.5 GeV/c per nucleon /sup 28/Si ions with nuclear targets using the BNL E802 spectrometer are presented. A description of the experiment and preliminary particle ratios are discussed.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

23631 **(CONF-890387—2) Anomalous positrons from heavy ion collisions: Past results and future plans.** Betts, R.R. (Argonne National Lab., IL (USA)). 1989. Contract W-31109-ENG-38. 31p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009800/JAW.

From Workshop on highly charged ions: new physics and advanced techniques; Berkeley, CA, USA (13 Mar 1989).

The current status of the experimental study of anomalous lines observed in the spectra of positrons produced in heavy ion collisions is reviewed. A new experiment to measure positron-electron coincidences is discussed. 26 refs., 14 figs., 2 tabs.

23632 **(CONF-890406—1) Nuclear shapes from spectroscopic studies of fission fragments.** Ahmad, I.; Emling, H.; Holzmann, R.; Janssens, R.V.F.; Khoo, T.L.; Phillips, W.R.; Drigert, M.W. (Argonne National Lab., IL (USA)). 1989. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000597/JAW.

From Fifty years with nuclear fission conference; Gaithersburg, MD, USA (25 Apr 1989).

Partial level schemes for several neutron-rich Ba and Ce nuclei have been determined from the study of gamma-gamma coincidences in ^{252}Cf fission fragments. The experiment was performed with the Argonne-Notre Dame gamma ray facility, which consisted of 7 Compton- suppressed Ge detectors, a low-energy photon spectrometer and an inner ball of fourteen hexagonal BGO detectors. Gamma-gamma coincidence events between the Ge detectors, which were accompanied by a gamma in BGO detectors, were accepted. The triple coincidence requirement eliminated most of the beta-decay background. Transitions in individual Ba and Ce nuclei were identified by gating on the known $2^+ \rightarrow O^+$ gamma rays. Level schemes deduced from these studies indicate interleaved negative and positive parity levels in ^{144}Ba, ^{146}Ba and ^{146}Ce which are connected by fast E1 transitions. Both these features are signature of octupole deformation (reflection asymmetric shape) and are reproduced by recent theoretical calculations. 4 refs., 1 fig., 1 tab.

23633 (INIS-BR—1440, pp 15) **Determination of efficiency and schemes of fission product decay with short half life in the fission of /sup 238/U by protons.** Bellido, A.V.; Cabral, S.C. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

23634 (INIS-BR—1441, pp 33-44) **Photoabsorption by heavy nuclei in the energy range 30-140 MeV.** Herdade, S.B.; Nemes, M.C.; Ferreira Filho, L.G.; Martins, M.N.; Dyrjanoj, M.C.; Paschoal, S.L.; Wolynec, E. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). 1986. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

Experimental methods for obtaining photoabsorption cross sections for heavy nuclei in the energy range 30-140 MeV are discussed, and results for /sup 237/Np obtained with the University of Sao Paulo Linear Acelerator are presented. The photoabsorption process, in the energy region considered, is described by means of modified versions of the quasi-deuteron model and by a kinetic phenomenological model here proposed. (authors).

23635 **(JINR—R-1-88-334) Inclusive production of π/sup 0/-mesons in pC-collisions at 4.5 GeV/c.** Abraamyan, Kh.U.; Arkhipov, V.V.; Astvatsaturov, R.G. and others. (Erevanskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705812/JAW.

Submitted to the Organizing Committee of the 9. International seminar on high energy physics problems, Dubna, Jun 1988.

Invariant inclusive cross section of the pC -> π/sup 0/X reaction at P=4.5 GeV/c has been measured as a function of X/sub F/=p/sub parallel/*p/sub max/* and p/sub perpendicular//sup 2/. The experimental data have been fitted by the functions: f(X/sub F/)=A/sub 1/(1-X/sub F/)/sup B//sub 1/ and dσ/dp/sub perpendicular//sup 2/=A/sub 2/exp(-B/sub 2/p/sub perpendicular//sup 2/). The following values have been obtained for A and B: A/sub 1/=(126+-21) mb/sup 12/C-nuclei; B/sub 1/=(2.72+-0.14), A/sub 2/=(19.5+-0.8) mb (GeV/c)/sup -2//sup 12/C-nuclei; B/sub 2/=(6.3+-0.2) (GeV/c)/sup -2/. 9 refs.; 7 figs.; 2 tabs.

23636 **(JINR—R-3-88-318) Experimental study of space parity violation of /sup 232/Th neutron resonances.** Alfimenkov, V.P.; Borzakov, S.B.; Mareev, Yu.D.; Pikel'ner, L.B.; Skoj, V.R.; Khrykin, A.S.; Sharapov, Eh.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1988. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88705828/JAW.

The results of the measurement of parity violation in the transmission of longitudinally polarized neutrons through a /sup 232/Th sample in the vicinity of /sup 232/Th p-wave resonances at E/sub p/=8.3 eV and E/sub p/=13.1 eV are presented. For the resonance at E/sub p/=8.3 eV a value of P=(1.8 +- 0.9)x10/sup -2/ is obtained for the total cross section asymmetry. For the resonance at E/sub p/13.1 eV this value is within the statistical error only. The results are analyzed in the frame of the model of weak compound level mixing and compared with the data obtained from measurements in the thermal energy range. 9 refs.; 2 figs.; 1 tab.

23637 **(LA-UR—88-3587) Neutron induced fission cross sections for ^{232}Th, /sup 235,238/U, ^{237}Np and ^{239}Pu from 1 to 400 MeV.** Lisowski, P.W.; Ullmann, J.L.; Balestrini, S.J.; Carlson, A.D.; Wasson, O.A.; Hill, N.W. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 5p. (CONF-890406—7). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89002296/JAW.

From Fifty years with nuclear fission conference; Gaithersburg, MD, USA (25 Apr 1989).

Neutron-induced fission cross section ratios for samples of ^{232}Th, /sup 235,238/U, ^{237}Np and ^{239}Pu have been measured from 1 to 400 MeV. The fission reaction rate was determined for all samples simultaneously using a fast parallel plate ionization chamber at a 20-m flight path. A well characterized annular proton recoil telescope was used to measure the neutron fluence up to 30 MeV. These data provided the shape of the ^{235}U(n,f) cross section relative to the hydrogen scattering cross section. That shape was then normalized to the very accurately known values were determined using the neutron fluence measured with a second proton recoil telescope. Cross section values for ^{232}Th, ^{238}U, ^{237}Np, and ^{239}Pu were computed from the ratio data using our values for ^{235}U(n,f). In addition to providing new results at high neutron energies, these data resolve long standing discrepancies among different data sets. 1 ref., 1 fig.

23638 **Heavy fragment radioactivity of /sup 238/Pu: Si and Mg emission.** Wang, S.; Snowden-Ifft, D.; Price, P.B.; Moody, K.J.; Hulet, E.K. (Physics Department, University of California, Berkeley, California 94720). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 4, 1647-1650(Apr 1989).

In addition to its two known hadronic decay modes: alpha decay (half-life 88 yr) and spontaneous fission (5 x 10/sup 10/ yr): we have found that /sup 238/Pu also decays by emission of a Mg nucleus ({similar←to}2 x 10/sup 18/ yr) and by emission of a Si nucleus ({similar←to}6 x 10/sup 17/ yr). This extends to four (the other two being /sup 14/C emission and Ne emission) the number of known modes of decay by emission of a fragment of mass between that of an alpha particle and that resulting from fission. The branching ratios relative to alpha decay are the lowest yet observed: {similar←to}6 x 10/sup -17/ for Mg emission and 1.4 x 10/sup -16/ for Si emission.

23639 **J/psi suppression in ultra-relativistic heavy-ion collisions.** Chu, M.-. (Center for Theoretical Physics Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, U.S.A.). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1017-1025(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We present a simple phenomenological model of J/psi suppression in ultra-relativistic heavy-ion collisions, which gives good agreement with the recent CERN NA38 data on 200 GeV/A Oxygen-Uranium collisions. The essential ingredients of our model are the existence of a characteristic energy density ϵ/sub s/ above which no J/psi could be formed, and Bjorken's longitudinal scaling hydrodynamics. With these assumptions, we deduce a lower bound on ϵ/sub s/ from the NA38 data: ϵ/sub s/$\geqq$1 GeV/fm^3. Fixing parameters from the Oxygen data, we also make predictions for 200 GeV/A Sulphur-Uranium interactions.

23640 **Measurement of the neutron-induced fission cross sections of /sup 242/Cm and /sup 238/Pu.** Alam, B.; Block, R.C.; Slovacek, R.E.; Hoff, R.W. (Univ. of Dhaka, Dept. of Physics, Dhaka-2 (BD); Rensselaer Polytechnic Institute, Dept. of Nuclear Engineering and Engineering Physics Gaertner LINAC Lab., Troy, NY (US); Knolls Atomic Power Lab., Niskayuna, NY (US); Lawrence Livermore National Lab., Livermore, CA (US)). *Nuclear Science and Engineering;* **99**: No. 3, 267-277(Jul 1988).

The neutron-induced fission cross sections of /sup 242/Cm and /sup 238/Pu have been measured from 0.1 eV to 100 keV using the Rensselaer Intense Neutron Spectrometer. Fission areas and widths were determined for several resolved low-energy resonances of /sup 242/Cm and /sup 238/Pu. The fission resonance integrals for /sup 242/Cm and /sup 238/Pu were found to be 12.9 +- 0.7 and 15.9 +- 0.6 b, respectively. The gross structure observed in the unresolved energy region of the /sup 242/Cm and /sup 238/Pu fission cross sections is suggestive of intermediate structure, and is consistent with the second well lying 2 to 3 MeV above the first well. The ENDF/B-V library fission cross section of /sup 238/Pu is, in general, not in good agreement with this measurement and a new evaluation is recommended. This is the first reported fission measurement of /sup 242/Cm in the 0.1-eV through 100-keV energy range.

23641 **Correlation of the signals from detectors in the presence of a stochastic neutron field.** Difilippo, F.C. (Oak Ridge National Lab., Engineering Physics and Mathematics Div., P.O. Box X, Oak Ridge, TN (US)). *Nuclear Science and Engineering;* **99**: No. 1, 28-35(May 1988).

The source of correlation for the signals from detectors in the presence of a stochastic neutron field is analyzed for a variety of circumstances. A general methodology, based on a master equation approach, is compared with the Langevin/Schottky method with the result that there is consistency if the detection process is included in detail. For cases where the detector removes the detected neutron, the only sources of correlation are elementary processes that produce more than one neutron; consequently, the Schottky prescription for the noise equivalent source must be corrected accordingly. An additional term because of the finite electronic resolution is also found and added to the noise equivalent source. Because of the relevance of the subject to the theory of the /sup 252/Cf source noise method to measure reactivities, the general results are applied to interpret a recently performed experiment with this type of source.

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REFER ALSO TO CITATION(S) 23263, 23492, 23493, 23497, 23499, 23503, 23533, 23541, 23554, 23564, 23599, 23603, 23615, 23627, 23627

23642 **(CEA-CONF—9680) Status of fission yield data.** Blachot, J.; England, T.R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale; Los Alamos National Lab., NM (US)). (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). 1988. 8p. (CONF-880546—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88757179/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

In this paper first we summarize the current status of the US evaluation for 34 fissioning nuclides at one or more neutron incident energies and for spontaneous fission. Currently there are 50 yields sets, and for each we have independent and cumulative yields and uncertainties for approximatively 1100 fission products. When finalized the recommended data will become part of the next version of the US ENDF/B VI. In a second part we review the different models developed to derive independent yields sets. The Zp and empirical models have been extensively studied for 6 fissioning nuclides. Comparison of model estimates with experimental data will be presented. The parameters for other fissioning systems will be derived by the use of systematic trends. A comparison of model estimates with some recent experimental data, obtained from Lohengrin (249 Cf T) will be given.

23643 **(CONF-890408—4) Photon cross sections for ENDF/B-VI.** Trubey, D.K.; Berger, M.J.; Hubbell, J.H. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number TI89005344/JAW.

From Advances in nuclear engineering computation and radiation shielding; Santa Fe, NM, USA (9 Apr 1989).

The PHOTX library of the National Institute of Standards and Technology will be used as the basis of File 23 (photon cross sections) for ENDF/B-VI. The PHOTX library is based on an experimental data base consisting of 21,000 data points from 512 literature sources for 82 elements. An important difference from earlier compilations is that renormalization of photo-effect cross sections is not performed. 40 refs., 12 figs.

23644 **(ICEFIZ-NP—61-1987) Search for pion emission in thermal neutron induced fission of /sup 235/U.** Ivascu, M.; Brehui, M.; Ion, D.B.; Petrascu, M.; Haiduc, M.; Topor, V.; Ion-Mihai, R.; Petrascu, C.; Tolstov, K. (Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania); Centrul de astronomie si stiinte spatiale, Bucuresti, Romania; Bucharest Univ. (Romania); Joint Inst. for Nuclear Research, Dubna (USSR)). (Central Inst. of Physics, Bucharest (Romania)). May 1987. 4p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706018/JAW.

Search for charged pion emission in the thermal neutron fission of /sup 235/U, was performed by the aid of nuclear emulsion technique. Only background events were found. An upper limit for the ratio GAMMA sub(π)/GAMMA sub(f) = 6.9 10/sup -9/ has been established. (authors).

23645 **(IFIN-NP—63-1987) STAPRE-H a computer code for particle induced activation cross sections and related quantities. Based on the Hauser-Feshbach statistical model and geometry dependent hybrid and exciton pre-equilibrium emission models.** Avrigeanu, M.; Ivascu, M.; Avrigeanu, V. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering). Dec 1987. 47p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706046/JAW.

STAPRE-H is an extension of the code STAPRE based on the Hauser-Feshbach statistical model and the "exciton model" for the pre-equilibrium emission accounting. The specific features of the code STAPRE-H are discussed, list of all input data and formats and sample problem input and output are given. (authors).

23646 **(IFIN-NP—64-1988) Fast neutron reaction data calculations with the computer code STAPRE-H.** Avrigeanu, M.; Ivascu, M.; Avrigeanu, V. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering). Jan 1988. 80p. NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88706047/JAW.

Description of the specific features of the version STAPRE-H are given. Illustration of the model options and parameter influence on the calculated results is done to trace the accurate reproducing of large body of correlated data. (authors).

23647 (INDC(CCP)—289/L, pp 15-28) **Elastic and quasi-elastic nucleon scattering on vanadium.** Titarenko, N.N.; Isakov, A.G.; Rudenskaya, E.O. Dec 1988. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705725/JAW.

Original report in Russian was distributed as INDC(CCP)-288/G.

In Translation of selected papers published in Nuclear Constants, No. 1, Moscow 1988.

A unified set of the neutron optical potential parameters for the /sup 51/V nucleus is sought in the 10 keV-32 MeV region so as to obtain a good agreement with all the available data. These include the neutron strength function and elastic scattering data as well as the neutron total cross-section and (p,n) isobaric analogue state quasi-elastic scattering data. (author). Refs, 6 figs, 3 tabs.

23648 (INDC(CCP)—289/L, pp 5-14) **/sup 239/Pu neutron cross-sections in the resolved-resonance region.** Luk'yanov, A.A.; Kolesov, V.V.; Toshkov, S.; Yaneva, N. Dec 1988. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88705725/JAW.

Original report in Russian was distributed as INDC(CCP)-288/G.

In Translation of selected papers published in Nuclear Constants, No. 1, Moscow 1988.

The authors have determined the multi-level parameters for description of the total and fission cross-sections for /sup 239/Pu in the resolved-resonance region up to 500 eV. A method has been developed for the construction of the elastic scattering and radiative capture resonance cross-sections using these parameters. The group-averaged cross-sections for experimental and evaluated data have been calculated in the energy region considered. (author). Refs, 4 tabs.

23649 (INIS-BR—1441, pp 23-32) **Trinucleon:a recent survey.** Adhikari, S.K. (Pernambuco Univ., Recife (Brazil). Dept. de Fisica). 1986. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

A survey of the trinucleon problem is presented. The starting point is historical development, which led to the tree-body treatment of the trinucleon system. Topics, such as, bound states and scattering states of trinucleon with (/sup 3/He) and without (/sup 3/H) Coulomb interaction, trinucleon asymptotic normalizations, formfactors, off-shell effect of two nucleon interaction, three-nucleon interaction, correlation among low energy trinucleon observables, effect of meson exchange current, and nucleon deuteron effective interaction, are discussed.

23650 (INIS-BR—1441, pp 85-96) **P-wave in the bound three-nucleon system and three-body forces.** Battistel, O.A.; Coelho, H.T. (Pernambuco Univ., Recife (Brazil). Dept. de Fisica). 1986. (In Portuguese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

A qualitative study of the coupling between the p-wave and the main s-state of the bound three-nucleon system is made througn the use of equipotential diagrams. The effect of three-body forces is investigated, being used the forms deduced by the Tucson-Melbourne and Sao Paulo - Recife groups. The latter is a redefined form from where the contact interactions are ruled out. A comparison with results obtained for the s and d waves shows that this effect is meaningfull, thus given clearer evidenas of the effects of these forces in bound three-nucleon systems, since the only contribution for this coupling come from the three-body forces. (L.C.).

23651 (INIS-BR—1441, pp 97-104) **Two-pion exchange three-nucleon potential - A new version.** Robillota, M.R. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). 1986. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

A redefined version of the three-nucleon potential with two-pion exchange assuming that it contains only Yukawa functions regularized at the origin is presented. (L.C.).

23652 (INIS-BR—1441, pp 105-109) **Scaling law in the tritium asymptotic normalization.** Frederico, T.; Adhikari, S.K.; Hussein, M.S. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados; Pernambuco Univ., Recife (Brazil). Dept. de Fisica; Sao Paulo Univ., SP (Brazil). Inst. de Fisica). 1986. (In Portuguese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

The ratio between the D and S normalizations of the tritium (eta /sup T/) is calculated with the one-nucleon exchange mechanism. It is obtained that eta/sup T/ is directly proportional to eta/sup D/ (deuteron D/S ratio) and that eta/sup T/ / eta/sup D/ is expressed as an analytical function of (E/sub T/ - E/sub D/) / E sub (D). (E/sub T/, E/sub D/, tritium and deuteron binding energy). (L.C.).

23653 (INIS-BR—1441, pp 73-84) **Lifetime of a nuclear hole state in a relativistic model.** Steffani, M.H.; Betz, M.; Maris, T.A.J. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica). 1986. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

The' imaginary part of the self energy of a hole in nuclear matter is calculated in the relativistic model of Walecka and compared with the observed widths of the holes created in quasi-free scattering experiments.

23654 (INIS-BR—1441, pp 1-21) **Non-locality effects in nuclear physics.** Rawitscher, G.H. (Connecticut Univ., Storrs (USA). Dept. of Physics). 1986. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

Some comments on non-locality effects in Nuclear Physics are discussed emphasizing that non-localities due to exchange effects are quite different from those due to channel coupling effects. The latter which can also be understood as dynamic nuclear polarization effects. (L.C.).

23655 (INIS-BR—1441, pp 64-72) **Statistical model of nuclear multifragmentation.** Donangelo, R.J. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1986. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

A statistical formulation of the multifragmentation of finite nuclei is given. The approach considers the generalization of the liquid-drop model for hot nuclei and how to determine probabilities of definite partitions of finite nuclei. The resulting mass spectra, multiplicity distributions and average values of temperature characterizing the nuclear ensemble at the disassembly stage are presented and discussed.

23656 (INIS-SU—71, pp 15-18) **Noneikonal corrections in the scattering problem on the strongly-absorbed potentials.** Belyak, V.I. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01; INIS. Order Number DE89780069/JAW.

Kratkie soobshcheniya po fizike.; no. 4.

In Experimental and theoretical physics. Collection.

Taking into account two noneikonal corrections, cross sections of scattering and absorption on hadron-nuclear optical potentials with strong boundary absorption are determined. The effective parameters of cross section expansions are obtained. A transition to a classical limit for elastic scattering is considered. 3 refs.

23657 **(INS—716) Possibility of H-particle production in high-energy nuclear collisions.** Sano, M.; Wakai, M.; Bando, H. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Nov 1988. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757230/JAW.

The H-particle production probability in nuclear collisions is formulated with a coalescence model and is calculated for Ne + Ne and p + Ne collisions at 5 GeV/nucleon. The total cross section of the H-particle production is about 2.6 μb in the Ne + Ne collisions and 0.2 μb in the p + Ne collisions.

23658 **(IYaF—88-15) Theoretical analysis of (e,e'N) and (γ,N) reactions on /sup 16/O.** Dmitriev, V.F.; Telitsin, V.B. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1988. 27p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706212/JAW.

Random phase approximation in continuum with effective forces has been used to calculate the cross sections of (γ, N) and (e, e'N) reactions on oxygen nucleus. The spectra of nucleons and their angular correlations are calculated. The comparison with experimental data was performed revealing importance of more complex than 1p-1h configurations contribution. 21 refs.; 14 figs.; 2 tabs.

23659 **(IYaF—88-38) Spin-isospin response of a nucleon at high excitation energy.** Dmitriev, V.F. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1988. 12p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706214/JAW.

The tensor analyzing power for p(d, /sup 2/He)Δ/sup 0/ reaction with polarized deuterons is discussed. General expressions for T/sub 20/ and T/sub 22/ for this reaction are derived. The models of π-exchange and π+rho-exchange does not reproduce the measured combination of T/sub 20/ and T/sub 22/. 7 refs.; 4 figs.

23660 (JINR—N-3-29-88, pp 5-17) **New possibilities for investigation of collective spin-spin interactions using dynamic cooling of radioactive nuclei.** Kiselev, Yu.F.; Lyuboshits, V.L.; Podgoretskij, M.I.; Chernikov, A.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780080/JAW.

In JINR rapid communications. Collection.

A new method is proposed for investigation of collective electron and electron-nuclear spin-spin interactions in hard dielectrics at very low temperatures. The method uses anisotropy of β-γ radiation in single and cascade decays of polarized nuclei. It is shown that anisotropy of radioactive nuclei radiation allows one to measure the spin temperature of nonradioactive nuclei polarized by means of dynamic cooling. Since the method is higly sensitive, it is enough to introduce {similar←to} 10/sup 14/ radioactive nuclei in the sample to be investigated. Analytical expressions are obtained for the angular distribution of γ-quanta produced in the series of consequent β- and γ-decays of polarized β-active nuclei. The cascade transition /sup 22/Na(3/sup +/) β-vector/sup 22/Ne(2/sup +/) γ-vector/sup 22/Ne(0/sup +/) is considered in detail. 15 refs.; 1 tab.

23661 **(JINR-E—2-88-77) Pauli-quenching for hadrons in nuclear matter - a quark substructure effect.** Blaschke, D.; Roepke, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. 16p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706224/JAW.

Submitted to the journal Z. Phys. A.

Starting from a string saturation model of quark interaction in a many-quark system, the Pauli quenching in the bound state phase is considered which leads to an energy shift comparable with the hard-core part of the Skyrme interaction. The Pauli quenching of quark bound states in nuclear matter can be related to the increase of the effective radii of nucleons. 14 refs.; 2 figs.; 1 tab.

23662 **(JINR-E—4-88-123) About ω/sup 0/ - exchange in (γ, π/sup 0/) reactions on proton and carbon near threshold.** Chumbalov, A.A.; Kamalov, S.S.; Tetereva, T.V. (Kazakhskij Gosudarstvennyj Univ., Alma-Ata (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; 4336000SU). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. 10p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706230/JAW.

Submitted to the journal Phys. Lett., B.

With the amplitudes obtained in the effective Lagrangian (BL) and the dispersion (BWD) methods the new data for the (γ, π/sup 0/) reaction on proton near the threshold are analysed. It has been found that the BL-amplitude gives the tensor to vector ratio of the ωNN coupling two times latger than the simple vector dominance model. The value of this ratio in the case of the BDW-amplitude has an opposite sign and is consistent with the results of other analyses. The new versions of the BL- and BDW-amplitudes lead to overestimated DWIA results for the (γ, π/sup 0/) process on carbon-12 at E/sub γ/ ~ 230 MeV and to good agreement with the data in the threshold and Δ/sub 33/ resonance region. 16 refs.; 4 figs.; 1 tab.

23663 **(JINR-E—4-88-158) Microscopic mean-field boson approach to the shape transition in Sm isotopes.** Kuchta, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. 23p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706231/JAW.

Submitted to the journal Nucl. Phys., A.

The phase transition from spherical to deformed shape in Sm/sup 146-156/ nuclei is analyzed within the mean-field approximation applied to the Dyson image of the shell-model Hamiltonian. No quasiparticle transformation is involved in the present approach and the Pauli principle in the physical boson subspace is properly taken into account. The low-lying spectra, B(E2; O/sub 1//sup +/->2/sup +/) probabilities and the corresponding densities of electromagnetic transitions are calculated. The results provide a reasonable explanation of the phase transition in the Sm isotopes. The role of bosons with different multipolarity is investigated and it is found that g-bosons (J=4) cannot be neglected in the transition region. Comparison of the present results with those of other approaches is given as well. 33 refs.; 7 figs.; 1 tab.

23664 **(JINR-E—4-88-229) New isospin invariant form of the interacting boson model.** Trajdos, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. 14p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706232/JAW.

Submitted to the journal J. Phys., G.

A simple version of the IBM with U(9) group structure is proposed to study the four-nucleon correlations induced by the interplay isovector and isoscalar components of the residual nuclear forces. Subgroup chains, bases, one-boson matrix elements, Casimir operators and eigenenergies of different limiting cases have been found. 13 refs.; 2 figs.; 4 tabs.

23665 **(JINR-R—4-88-170) Pauli principle and magnetic moments of odd spherical nuclei.** Safarov, R.R.; Vdovin, A.I.; Galinskij, E.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706252/JAW.

Submitted to the Organizing Committee of the 38-th Meeting on nuclear Spectroscopy and atomic nuclear structure, Baku, Apr 1988.

Magnetic momenta μ/sub tau/ of low-lying states in odd Sn, Sb and Y isotopes are calculated in the framework of the model, which takes into account the relation between an odd quasiparticle and quadrupole, octapole and magnetic dipole phonons. The phonon structure is calculated in the approximation of a random phase with separable particle-hole forces. The effect of the Pauli principle acting between the odd quasiparticle and quasiparticles forming phonons on μ/sub tau/ is investigated. In some cases corrections related to the action of the Pauli principle are turned out to be essential. Isoscalar spin interaction influences weakly the μ/sub tau/ value. 8 refs.; 2 tabs.

23666 **(LA-UR—89-860) Nuclear fission: An inherently non-equilibrium process?.** Gavron, A. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 8p. (CONF-890491—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009391/JAW.

From International conference on fifty years of research in nuclear fission; Berlin, F.R. Germany (3 Apr 1989).

Recent measurements of neutron emission in coincidence with fission fragments indicate a strong enhancement of the neutron multiplicity preceding fission compared with statistical model calculations. This enhancement has enabled the determination of the reduced nuclear dissipation coefficient β which, in turn, indicates that nuclear collective motion is overdamped. We examine some possible sources of error in this determination and speculate on the consequences of the obtained value of β.

23667 **(LA-UR—89-1012) X and Y scaling.** West, G.B. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 18p. (CONF-8810118—5). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009347/JAW.

From Workshop on momentum distributions; Argonne, IL, USA (24 Oct 1988).

Although much of the intuition for interpreting the high energy data as scattering from structureless constituents came from nuclear physics (and to a lesser extent atomic physics) virtually no data existed for nuclear targets in the non-relativistic regime until relatively recently. It is therefore not so surprising that,in site of the fact that the basic nuclear physics has been well understood for a very long time, the corresponding non-relativistic scaling law was not written down until after the relativistic one,relevant to particle physics, had been explored. Of course, to the extent that these scaling laws simply reflect quasi-elastic scattering of the probe from the constituents, they contain little new physics once the nature of the constitutents is known and understood. On the other hand, deviations from scaling represent corrections to the impulse approximation and can reflect important dynamical and coherent features of the system. Furthermore, as will be discussed in detail here, the scaling curve itself represents the single particle momentum distribution of constituents inside the target. It is therefore prudent to plot the data in terms of a suitable scaling variable since this immediately focuses attention on the dominant physics. Extraneous physics, such as Rutherford scattering in the case of electrons, or magnetic scattering in the case of thermal neutrons is factored out and the use of a scaling variable (such as y) automatically takes into account the fact that the target is a bound state of well-defined constituents. In this talk I shall concentrate almost entirely on non-relativistic systems. Although the formalism applies equally well to both electron scattering from nuclei and thermal neutron scattering from liquids, I shall, because of my background, usually be thinking of the former. On the other hand I shall completely ignore spin considerations so, ironically, the results actually apply more to the latter case!

23668 **Angular momentum dependence of the absorptive optical potential.** Madsen, V.A.; Osterfeld, F. (Oregon State University, Corvallis, Oregon 97331). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 4, 1215-1221(Apr 1989).

It is shown that the expected nonlocality in the imaginary optical potential implies a dependence on the projectile orbital angular momentum l. First, as a model of this effect, a potential with a Gaussian dependence on the nonlocal coordinate is expanded in multipoles, and the local equivalent potential is calculated using the Perey-Saxon method. It is shown that the local approximation tends to compensate for the falloff with l of the multipole expansion because of the smaller local radial wave number for higher l values. The l dependence of the resulting local equivalent potential depends fairly sensitively on whether or not the assumed Gaussian nonlocality is spherical. For a nonlocality that is greater in the angular direction than in the radial direction, there is a distinct residual falloff of the local-equivalent potential with l. Second, the local approximation has also been made to the l-dependent nonlocal potential resulting from the microscopic nuclear structure approach to the imaginary optical potential. It is found that although there is a considerable falloff of the imaginary optical potential with angular momentum as in the Gaussian model, the l dependence is somewhat erratic.

23669 **Low-energy nucleon-deuteron scattering.** Chen, C.R.; Payne, G.L.; Friar, J.L.; Gibson, B.F. (Department of Physics and Astronomy, University of Iowa, Iowa City, Iowa 52242). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 4, 1261-1268(Apr 1989).

The configuration-space Faddeev equations for the nucleon-deuteron scattering problem are solved for energies below the three-body breakup threshold. We extract the s-wave scattering lengths from fits to the calculated effective range functions, and the results are in good agreement with our previous zero-energy calculations. For the pd-doublet case we find a pole at negative energies which lies closer to the physical region than that for the nd-doublet case. Our calculated phase shifts fall within the existing experimental error bars, suggesting that accurate experiments for scattering energies below 0.3 MeV are necessary in order to obtain a reliable experimental estimate of the pd-doublet scattering length.

23670 **Production of $\pi 0$ in the Coulomb field of nuclei by virtual photons from electron scattering.** Hadjimichael, E.; Fallieros, S. (Physics Department, Fairfield University, Fairfield, Connecticut 06430). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 4, 1438-1445(Apr 1989).

We explore the cross section for π^0 production by virtual photons from electron scattering, interacting with the Coulomb field of heavy nuclei. The same process with real photons, generally known as the Primakoff effect, has been used in the past to investigate the π^0 lifetime. In the present work, virtual photons bring into focus the electromagnetic structure of the $\gamma\gamma\pi^0$ vertex.

23671 **Shell model study of /sup 40/S(βp)/sup 40/Cl and the energy levels of /sup 40/Cl.** Warburton, E.K.; Becker, J.A. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 4, 1535-1543(Apr 1989).

Shell-model calculations are performed for the odd- and even-parity states of /sup 40/Cl and the 0^+ /sup 40/S ground state. The /sup 40/Cl odd-parity states and the /sup 40/S 0^+ levels were considered in full (2s,1d)/sup 21/(1f,2p)^3 and (2s,1d)/sup 20/(1f,2p)^4 configurational spaces, respectively. For the /sup 40/Cl even-parity states it was necessary to use a highly truncated (2s,1d)/sup 20/(1f,2p)^4 configurational space. Besides energy spectra and binding energies, observables calculated are first-forbidden and allowed β^- decay of /sup 40/S, γ transitions in /sup 40/Cl, and one-body density overlaps of the odd-parity states of /sup 40/Cl with the /sup 40/Ar ground state. The results are compared to experiment. For example, the half-life of /sup 40/S is predicted to be in the range 6.2--16.6 s (depending on the assumed level scheme) as compared to the experimental value of 8.8 +- 2.2 s.

23672 **Relativistic calculation of the deuteron quadrupole and magnetic moments.** Chung, P.L.; Keister, B.D.; Coester, F. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 4, 1544-1549(Apr 1989).

The deuteron quadrupole and magnetic moments are calculated assuming light-front dynamics. The advantage of this approach is that conventional bound-state wave functions and empirical nucleon form factors can be used to construct eigenfunctions of the four-momentum and the spin, together with a representation of the electromagnetic current, in such a way that the current-density operator and the wave functions transform consistently under a unitary representation of the Poincare group. The sensitivity of our model to the choice of the deuteron bound-state wave functions is tested by using Reid soft core, Argonne v/sub 14/, Paris, and Nijmegen nucleon-nucleon interactions, as well as three Bonn potentials. The exact results increase both quadrupole and magnetic moments by small amounts compared to the nonrelativistic values. Expansions in powers of the nucleon velocity are found to be unreliable.

23673 **Thermal-neutron scattering lengths and capture by even calcium isotopes.** Raman, S.; Kahane, S.; Moon, R.M.; Fernandez-Baca, J.A.; Zarestky, J.L.; Lynn, J.E.; Richardson J.W. Jr. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **39**: No. 4, 1297-1306(Apr 1989).

Neutron-diffraction patterns have been measured for isotopically enriched powder samples of calcite using both steady-state and pulsed-neutron techniques. Greatly enhanced precision over previous work has been achieved for /sup 40/Ca and /sup 44/Ca,

while the results for /sup 42/Ca, /sup 43/Ca, and /sup 48/Ca represent new data. The coherent scattering lengths deduced from these measurements have been employed in a more definitive analysis of primary electric-dipole gamma rays from thermal-neutron capture. In three cases (/sup 40/Ca, /sup 42/Ca, and /sup 48/Ca) the estimates from a spherical optical-model formulation of the direct-capture mechanism are in agreement with the experimental cross sections. In /sup 44/Ca the theory overestimates the measured cross sections on average by about 60%; this divergence can be explained by considering the modifications to the theory due to collective vibrations of the /sup 44/Ca core.

23674 **Pion production and distribution in grazing relativistic heavy-ion collisions: A Monte Carlo method.** Radi, H.M.A.; Mehrem, R.A.; Rasmussen, J.O. (Physics Department, Faculty of Science, Kuwait University, Kuwait Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] C: Nuclear Physics;* **39**: No. 4, 1340-1350(Apr 1989).

Lorentz-invariant cross sections for the production of π^0, π^+, and π^- have been investigated, for the pion c.m. momentum range 0--0.5 GeV/c at angles 0°--90°, by Monte Carlo methods for grazing nuclear collisions of /sup 207/Pb+/sup 207/Pb at 0.4 GeV/nucleon. Pions are considered to be produced isotropically at the center of mass at closest approach at random from a Gaussian momentum distribution. The pion equations of motion are solved including the electromagnetic effects due to the projectile and target /sup 207/Pb nuclei. The trajectory calculations differ from some earlier theoretical work in that pions are considered to scatter from the surface of, and propagate within, a spectator fragment. After surface scattering, the trajectory calculations continue but are weighted by the pion reflectivity. For that purpose, a model developed by Mehrem et al., for the relativistic oblique incidence of pions on nuclear matter represented by a uniform complex nuclear potential, has been used to evaluate the pion reflectivity for the three types of pions.

23675 **Medium modifications of the neutron charge form factor.** Meissner, U. (Center for Theoretical Physics, Laboratory for Nuclear Science Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* **62**: No. 9, 1013-1016(27 Feb 1989).

We discuss the behavior of the neutron charge form factor in a nuclear environment using the framework of a chiral πrhoω Lagrangian. For momentum transfers of 0.4 $(GeV/c)^2$ and larger, the medium renormalization of fundamental meson parameters leads to a sizable decrease in the neutron charge form factor. This effect might be seen in an upcoming high-precision experiment to determine the electric form factor of the neutron through scattering of polarized electrons from polarized ^{3}He. We also find that the effective nucleon mass and axial-vector coupling constant g/sub A/ are quenched.

23676 **Hypernuclear interactions and the binding energies of Λ and ΛΛ hypernuclei.** Bodmer, A.R.; Usmani, Q.N. (Department of Physics, University of Illinois at Chicago, Chicago, IL 60680 Physics Division, Argonne National Laboratory, Argonne, IL 60439-4843 USA). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 710-718(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

By use of variational calculations a reasonable hadronic description is obtained of the s-shell hypernuclei, of ^{9}/sub Λ/Be, and of the well depth, with ΛN forces which are consistent with Λp scattering and which are quite strongly spin-dependent, with reasonable TPE ΛNN forces and with strongly repulsive dispersive-type ΛNN forces. For the latter we also consider a spin-dependent version which is somewhat favored by our analysis. ^{9}/sub Λ/Be is treated as a 2α+Λ system and is significantly overbound, ≃ MeV, if only αα and αΛ potentials are used. An ααΛ potential obtained from the ΛNN forces nicely accounts for this overbinding. The ΛΛ hypernuclei /sub Λ//sub Λ/^{6}He and /sub Λ//sub Λ/^{10}Be are treated as α+2Λ and 2α+2Λ systems. Use of the /sub Λ//sub Λ/^{10}Be event gives ≃1.5 MeV too little binding for /sub Λ//sub Λ/^{6}He. The $^1S_0$ Λ/sub Λ/ potential obtained from ^{10}/sub Λ//sub Λ/Be is quite strongly attractive, comparable to the ΛN and also to the NN potential without OPE.

23677 **Systematics of the Σp, Σ⁰ and Σ⁺ hypernuclear single particle states.** Divadeenam, M.; Ward, T.E.; Millener, D.J. (Neutral Beam Division, Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 819-823(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Local density dependent Hartree-Fock potentials in analogy with the Λ° hypernuclear single particle description by Millener, Dover and Gal were employed to investigate the systematics of the Σ hypernuclear single particle states. Both charge and isospin dependent (Lane potential) one-body potentials were used to describe the Σ⁻, Σ⁰ and Σ⁺ single particle (s.p.) states for Σ hypernuclei in the mass range 6--40 with core--nucleus isospin T/sub c/ = 1/2. Due to the smaller magnitude of the Σ-nucleus potential the coulomb effects are dominant, especially for nuclei towards A = 40, while the isospin dependent potential has strong effect for the lighter nuclei due to the A^{-1} dependence of the Lane potential.

23678 **Nuclear dependence of parton distributions.** Close, F.E. (Physics Department, University of Tennessee, Knoxville, TN 37996 U.S.A. Oak Ridge National Laboratory, Oak Ridge, TN 37831-6373 U.S.A.). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 765-777(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

I review the emerging formation on the way quark, antiquark, and gluon distributions are modified in nuclei relative to free nucleons. I place particular emphasis on Drell-Yan and psi production on nuclei and caution against premature use of these as signals for quagma in heavy-ion collisions.

23679 **Summary of the relativistic heavy ion sessions.** Harris, J.W. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 241-247(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The topics covered in the Relativistic Heavy Ion Sessions span four orders of magnitude in energy in the laboratory and a few more in theory. In the two years since the last Intersections conference, experiments in the field of very high energy heavy ion research have begun at CERN and Brookhaven. The prime motivation for these experiments is the possibility of forming quark matter. This paper is a review of the topics covered in the Relativistic Heavy Ion Sessions. (AIP)

23680 **String models for ultrarelativistic heavy ion collisions: Lund model versus color exchange models.** Werner, K. (Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 1053-1059(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We discuss similarities and differences between several string models for ultrarelativistic nucleus nucleus scattering, being proposed to account for "normal" collisions (with no quark gluon plasma involved).

23681 **Exchange effects in double beta decay.** Stephenson G.J. Jr.; Goldman, T.; Maltman, K.R.; Schmidt, K.E. (University of New Mexico, Albuquerque, NM 87106). *AIP (American Institute of Physics) Conference Proceedings;* **176**: No. 1, 930-935(20 Nov 1988). (CONF-8805142—).

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The motivation underlying the resurgence of interest in double beta decay is the hope that the observation of or limits on the 0-neutrino mode will provide information about the nature of the neutrino. This clearly requires confidence in the nuclear matrix elements involved in the transition. The shell model calculations do not agree well with the geochemical values for ^{130}Te, which has lead to a spate of papers offering specific fixes for the problem. In this contribution we shall not comment on any of the specific nuclear calculations, rather we make some remarks which should be relevant to any model calculation. (AIP)

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 22103, 22992, 23563, 23641

23682 **(CONF-890408—3) Generation of broad-group neutron/photon cross-section libraries for shielding applications.** Ingersoll, D.T.; Roussin, R.W.; Fu, C.Y.; White, J.E. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE88016808/JAW.

From Advances in nuclear engineering computation and radiation shielding; Santa Fe, NM, USA (9 Apr 1989).

The generation and use of multigroup cross-section libraries with broad energy group structures is primarily for the economy of computer resources. Also, the establishment of reference broad-group libraries is desirable in order to avoid duplication of effort, both in terms of the data generation and verification, and to assure a common data base for all participants in a specific project. Uncertainties are inevitably introduced into the broad-group cross sections due to approximations in the grouping procedure. The dominant uncertainty is generally with regard to the energy weighting function used to average the pointwise or fine-group data within a single broad group. Intelligent choice of the weighting functions can reduce such uncertainties. Also, judicious selection of the energy group structure can help to reduce the sensitivity of the computed responses to the weighting function, at least for a selected set of problems. Two new multigroup cross section libraries have been recently generated from ENDF/B-V data for two specific shielding applications. The first library was prepared for use in sodium-cooled reactor systems and is available in both broad-group structures. The second library, just recently completed, was prepared for use in air-over-ground environments and is available in a broad-group (46-neutron, 23-photon) energy structure. The selection of the specific group structures and weighting functions was an important part of the generation of both libraries.

23683 **(CONF-890408—6) MASH, the Monte Carlo adjoint shielding code.** Emmett, M.B.; Rhoades, W.A.; Johnson, J.O. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006126/JAW.

From Advances in nuclear engineering computation and radiation shielding; Santa Fe, NM, USA (9 Apr 1989).

The Monte Carlo Adjoint Shielding code (MASH) calculates protection factors for armored military vehicles by coupling a forward discrete ordinates calculation with an adjoint Monte Carlo calculation. The discrete ordinates calculation determines the fluence on a coupling surface surrounding the vehicle due to an external neutron/photon source. The Monte Carlo calculation determines the effectiveness of the fluence at that surface in causing a response in a detector within the vehicle, i.e., the "dose importance" of the surface fluence. A coupling code folds the fluence together with the dose importance, giving the desired dose response. This coupling code can also rotate the vehicle, move it to different distances from the source, and perturb the energy response of the detector. 10 refs., 4 figs., 2 tabs.

23684 **(EUR—11767) Neutron spectrometry measurements in iron.** Perlini, G.; Acerbis, S.; Carter, M. (Commission of the European Communities, Ispra (IT). Joint Research Centre; UKAEA Atomic Energy Establishment, Wingrith). (Commission of the European Communities, Luxembourg). 1988. 81p. NTIS (US Sales Only), PC A05/MF A01. Order Number TI88757202/JAW.

A compact structure was prepared for use in making measurements of neutron penetration in iron which could serve as reference data and as a check for computer codes. About 30 iron plates were put together giving a useful overall length of 130 cm. At various depths along the central axis of the iron block, measurements were made with liquid scintillator spectrometers and proton recoil proportional counters. The energy band explored was between 14 KeV and 10 MeV. Here we report the original spectra of the impulses and the neutron spectra found by the NE213 code based on the differential method and by unfolding with the SPEC4 code for liquid scintillation counters and proton recoil spectrometers, respectively. 12 figs., 60 tabs., 6 refs.

23685 (INIS-SU—75, pp 9-14) **Problems of improving the software for simulation of gamma radiation fields in NPP coolant circuits.** Bychkov, Ya.A. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780081/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Construction and building. Scientific-technical collection.

Based on the literature data analysis and design experience the modern state of computer application to forecast NPP coolant circuit γ radiation fields is discussed. Basic factors determining the error of γ radiation field forecasting are indicated. Problems to be solved for increasing the accuracy of algorithms and constant supply of the methods of irradiation analysis, accumulation factor and albedo applied when creating the programs under consideration, are formulated. 10 refs.

23686 **(INT—190/I) Activation method of fast neutron excitation function determination.** Janczyszyn, J. (Institute of Physics and Nuclear Techniques, Krakow (Poland)). 1985. 12p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706201/JAW.

An idea of a method is presented, in which a number of semi-monoenergetic neutron sources is used for the activation of a set of reference reaction foils together with the foil of the unknown excitation function. Basing on known excitation functions of threshold reference reactions, first, spectra of the neutron sources and, next, the unknown excitation function are unfolded. The functional representation of σ(E) and energy distribution of the neutron flux density is assumed. Formulas for (n,2n), (n,3n), (n,p) and (n,np) reaction cross sections are cited and formula for semi-monoenergetic neutron spectrum is proposed. 15 refs., 2 figs.

23687 **(JAERI—1314) One-, two- and three-dimensional transport codes using multi-group double-differential form cross sections.** Mori, Takamasa; Nakagawa, Masayuki; Sasaki, Makoto. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Nov 1988. 159p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88757243/JAW.

We have developed a group of computer codes to realize the accurate transport calculation by using the multi-group double-differential form cross section. This type of cross section can correctly take account of the energy-angle correlated reaction kinematics. Accordingly, the transport phenomena in materials with highly anisotropic scattering are accurately calculated by using this cross section. They include the following four codes or code systems: PROF-DD : a code system to generate the multi-group double-differential form cross section library by processing basic nuclear data file compiled in the ENDF / B-IV or -V format, ANISN-DD : a one-dimensional transport code based on the discrete ordinate method, DOT-DD : a two-dimensional transport code based on the discrete ordinate method, MORSE-DD : a three-dimensional transport code based on the Monte Carlo method. In addition to these codes, several auxiliary codes have been developed to process cal-

culated results. This report describes the calculation algorithm employed in these codes and how to use them.

23688 **(LA-UR—89-325) A diffusion accelerated Sn transport method for radiation transport on a general quadrilateral mesh.** Alcouffe, R.E. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 15p. (CONF-890438—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007753/JAW.

From American Nuclear Society meeting; Santa Fe, NM, USA (9 Apr 1989).

We present the development of a diffusion accelerated Sn transport method for the solution of temperature coupled radiation flow problems on a spatial mesh of arbitrary quadrilaterals in R-Z geometry. The diffusion acceleration equation is derived from the diamond-like transport spatial discretization. The effectiveness of the DSA method is shown on an example calculation and also computation times are indicated. 3 refs., 3 figs.

23689 **(LA-UR—89-359) A chaotic, single-pass inner-iteration scheme for the discrete ordinate method S/sub n/.** Hiromoto, R.; Wienke, B.R. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 18p. (CONF-890408—10). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007751/JAW.

From Advances in nuclear engineering computation and radiation shielding; Santa Fe, NM, USA (9 Apr 1989).

A chaotic, single-pass inner-iteration scheme for the deterministic transport algorithm S/sub n/ is presented. The single-pass scheme is a slight modification to the standard iterative S/sub n/ method. In the standard scheme, an energy group may make multiple sweeps through the inner iteration loop before satisfying a convergence criterion that controls the group's termination of the iteration loop. In the single-pass scheme, only a single inner-iteration pass is allowed for each energy group. This scheme is executed both sequentially and in parallel. The parallel implementation executes without synchronizing the updates of the outer flux, whose iterates are passed between higher and lower energy groups during the inner iteration. This unsynchronized access to the outer flux represents the chaotic nature of this algorithm. The performance of the single-pass scheme is presented in terms of execution times and total number of inner-iteration counts required for the solution of the particular source calculation. The paper also examines the effects due to different problem (input) specifications. 7 refs., 12 figs.

23690 **(LA-UR—89-439) Neutronics computational applications of symmetry algebras.** Axford, R.A. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 17p. (CONF-890408—9). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007760/JAW.

From Advances in nuclear engineering computation and radiation shielding; Santa Fe, NM, USA (9 Apr 1989).

Lie groups of point transformations and their corresponding symmetry algebras are determined for a general system of second order differential equations, special cases of which include the multigroup diffusion equations and the "FLIP form" of the P/sub L/ equations. It is shown how Lie symmetry algebras can be used to motivate, formulate and simplify double sweep algorithms for solving two-point boundary value problems that involve systems of second order differential equations. A matrix Riccati equation that appears in double sweep algorithms is solved exactly by regarding a set of first integrals of the second order system as a set of first order differential invariants of the group of point transformations that is admitted by the system. A second computational application of symmetry algebras is the determination of invariant difference schemes which are defined as difference schemes that admit the same groups of point transformations as those admitted by the differential equations that they simulate. Prolongations of symmetry algebra vector fields that are required to construct invariant difference equations are defined and found. Examples of invariant difference schemes are constructed from the basic difference equation invariance conditions and shown to be exact. 15 refs.

23691 **(LA-UR—89-765) Shielding concerns at a spallation source.** Russell, G.J.; Robinson, H.; Legate, G.L.; Woods, R. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 11p. (CONF-8810182—23). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009406/JAW.

From International collaboration on advanced neutron sources (ICANS); Los Alamos, NM, USA (3 Oct 1988).

Neutrons produced by 800-MeV proton reactions at the Los Alamos Neutron Scattering Center spallation neutron source cause a variety of challenging shielding problems. We identify several characteristics distinctly different from reactor shielding and compute the dose attenuation through an infinite slab/shield composed of iron (100 cm) and borated polyethylene (15 cm). Our calculations show that (for an incident spallation spectrum characteristic of neutrons leaking from a tungsten target at 90{degree}) the dose through the shield is a complex mixture of neutrons and gamma rays. High-energy (> 20 MeV) neutron production from the target is ≅5% of the total, yet causes ≅68% of the dose at the shield surface. Primary low-energy (< 20 MeV) neutrons from the target contribute negligibly (≅0.5%) to the dose at the shield surface yet cause gamma rays, which contribute ≅31% to the total dose at the shield surface. Low-energy neutrons from spallation reactions behave similarly to neutrons with a fission spectrum distribution. 6 refs., 8 figs., 1 tab.

6550 Medical Physics

REFER ALSO TO CITATION(S) 22013, 22070

23692 **(CEA-DAS—551) Minutes of the meeting on establishing release rates and leakage tests for packagings used for the transportation of radioactive substances.** Tanguy, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Dec 1988. 14p. (CONF-8805278—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757343/JAW.

From International Organization for Standardization (ISO) Technical Committee 85; London, UK (26 May 1988).

Detailed discussion for drafting the ISO standard is reported. The standard ANSI N 14.5 is used as a basis questions raised, list of actions decided and agenda of the third meeting of the working group are given.

23693 **(ICRU—44) Tissue substitutes in radiation dosimetry and measurement.** (International Commission on Radiation Units and Measurements, Bethesda, MD (USA)). 15 Jan 1989. 197p. International Commission on Radiation Units and Measurements, 7910 Woodmont Avenue, Suite 800, Bethesda, MD 20814-3095 $22.00.

This report initially gives the physical quantities that should be considered when tissue substitutes are selected for dosimetric studies and other measurements using photons (10 KeV to 100 MeV), electrons (10 keV to 100 MeV), neutrons (25 meV to 100 MeV) and heavy charged particles (1 to 500 MeV) (Sections 2 and 3). The important human body tissues requiring simulation are discussed and their elemental compositions, mass densities, and electron densities are tabulated (Section 4). Comparative interaction and depth-dose data for selected tissue substitutes are presented (Section 5). Conclusions are given in the final section. The Appendices include detailed tabulations of the elemental compositions and physical characteristics of the tissue substitutes considered; the interaction data for all the body tissues and tissue substitutes quoted in the report, and an outline of the formulation and fabrication techniques used in the production of tissue substitute materials. 168 refs.

23694 **(IKE—6-176) Determination of two- and three-dimensional radiation fields for neutron radiotherapy planning.** Boehm, J.K. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme; Stuttgart Univ. (Germany, F.R.)). Jan 1986. 142p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88757361/JAW.

The thesis deals with the computerized investigations for fast neutron radiotherapy planning, explaining the calculation and modelling of local dose distributions in patients as a result of mixed neutron and gamma radiation fields. For a computed irradiation program (elaborated for instance by the COMRAD program system), dose distribution functions are required for the simulation of multifield or moving beam irradiations, the functions being derived semiempirically by non-linear regression. The necessary data on stationary field doses are derived by measurements or by computed simulation with specific transport programs from the nuclear engineering sector. Transport calculations show the effects of inhomogeneities in the patient's body on the dose distribution. The determined, strong inhomogneity effects (lungs, head) have to be taken into account as precisely as possible in order to achieve optimum irradiation planning.

23695 (Juel-Conf—62, pp 24-32) **Development of a model for statistical simulation of individual dose distribution in the population due to recycling of iron alloys from nuclear installations.** Goertz, R.; Graf, R.; Brenk, H.D. (Brenk Systemplanung Ingenieurbuero fuer Wissenschaftlich-Technischen Umweltschutz, Aachen (Germany, F.R.)). Jul 1988. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW. (CONF-8711296—).

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

Repair, backfitting, or dismantling of nuclear installations brings about considerable amounts of iron or steel scrap as residual material that can be recycled after decontamination to a suitably low level of radiation so that the population dose remains within the limits to be set. For this purpose, regulatory procedures and data are to be determined that have to be observed prior to recycling. The manifold variety of practical reuse, or exposure pathways, can be simulated by a stochastic model which takes into account, for instance, the characteristic data of the scrap processing steps and the materials flow involved, which is deluted, mixed, separated, or rejoined. The radiological conditions during the various steps are simultaneously simulated by the model.

23696 (Juel-Conf—62, pp 33-50) **'Radiological principles to be applied for harmless recycling and reuse of low-level radioactive steel and iron scrap from nuclear power plant', a recommendation of the SSK.** Neider, R. (Bundesanstalt fuer Materialforschung und -pruefung, Berlin (Germany, F.R.)). Jul 1988. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88757375/JAW. (CONF-8711296—).

From Seminar on reuse of residual materials from repair and dismantling of nuclear facilities; Juelich, F.R. Germany (10 Nov 1987).

The recommendation presented here has been worked out over several years by the SSK (Strahlenschutzkommission) and an SSK sub-comittee on 'Radiological protection with regard to radioactive scrap and other residual materials'. The recommendation is concerned with: (a) Unconditional release for reuse; (b) radiation limits for scrap accepted for unrestricted reuse; (c) radiation limits for restricted reuse of scrap. The recommendation explains the criteria and limits defined.

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REFER ALSO TO CITATION(S) 22011, 22497, 22530, 22537, 22611, 22636, 22678, 22692, 22717, 22751, 22798

23697 **(BNL—41404) EXAFS studies of multilayer interfaces.** Heald, S.M.; Lamble, G.M. (Brookhaven National Lab., Upton, NY (USA). Medical Dept.). 1988. Contract AC02-76CH00016. 13p. (CONF-881155—55). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009527/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

Important for the understanding of multilayer materials is a determination of their interface structure. The extended x-ray absorption fine structure (EXAFS) technique can be useful, particularly for interfaces with a high degree of structural disorder. This paper reviews the application of EXAFS to multilayers, and describes the standing wave enhancement of the EXAFS from multilayer interfaces. Examples are given for W-C and Ni-Ti multilayers. 6 refs., 6 figs.

23698 **(DOE/ER/45107—10) Kinetic and spectroscopic probes to evaluate the dimensionality of triplet exciton migration in polymeric systems.** Burkhart, R.D.; Siu, T.J.K.S. (Nevada Univ., Reno (USA)). 1988. Contract FG08-84ER45107. 6p. (CONF-880110—36). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009315/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

The rate of decay of triplet excitons following a photoexcitation pulse has been determined for poly(2-vinylnaphthalene) in a variety of solvents at ambient temperature and at 77 K. A three dimensional model for exciton diffusion fits the data at ambient temperature but at 77 K the data are not well represented by a single integral dimensionality. 7 refs., 1 tab.

23699 **(FRCEA-TH—150) Instrument developments for inverse photoemission.** Brenac, A. (Grenoble-1 Univ., 38 (France); CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). Feb 1987. 220p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88757352/JAW.

Experimental developments principally concerning electron sources for inverse photoemission are presented. The specifications of the electron beam are derived from experiment requirements, taking into account the limitations encountered (space charge divergence). For a wave vector resolution of 0.2 A/sup -1/, the maximum current is 25 microA at 20 eV. The design of a gun providing such a beam in the range 5 to 50 eV is presented. Angle-resolved inverse photoemission experiments show angular effects at 30 eV. For an energy of 10 eV, angular effects should be stronger, but the low efficiency of the spectrometer in this range makes the experiments difficult. The total energy resolution of 0.3 eV is the result mainly of electron energy spread, as expected. The electron sources are based on field effect electron emission from a cathode consisting of a large number of microtips. The emission arises from a few atomic cells for each tip. The ultimate theoretical energy spread is 0.1 eV. This value is not attained because of an interface resistance problem. A partial solution of this problem allows measurement of an energy spread of 0.9 eV for a current of 100 microA emitted at 60 eV. These cathodes have a further advantage in that emission can occur at a low temperature.

23700 **(IAE—4549/11) Study of the stopping power of charged particles and formation of point radiation defects in ion-irradiated materials.** Lizunov, Yu.D.; Ryazanov, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 37p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706154/JAW.

Systematic analysis of theoretical methods for determining distribution parameters of various physical values a t ion irradiation of materials is given. The features of the new method based on a numerical solution of Boltzmann kinetic equat ion for moving ions and target atoms knocked-on in collisions at the system phase space are indicated in detail. The present met hod makes it possible in a single way to determine the values re lated to a radiation damage of materials (including multicompone nt) over a wide range of ion energies. The survery of various ex perimental techniques for determining distributions of implanted ions and initial radiation damages created by them during irradiation, is given. Experimental data are compared with calculated ones are compared with calculated ones. 49 refs.; 11 figs.; 2 tabs.

23701 **(IAE—4555/11) On the applicability of various planar potentials in the theory of ultrarelativistic electron channeling.** Chaplanova, I.N.; Beloshitskij, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706155/JAW.

The calculations of the dechanneling function and the crystal effective thickness were carried out in channeling ultrarelativistic electrons in diamond, plane (110), for various models of a planar potential. From the analysis of results, the conclusion was made on the applicability of a simplified parabolic potential to describe the channeling process. 6 refs.; 2 figs.

23702 **(INIS-mf—11365) Elastic and inelastic neutron scattering studies on 3d and 4f magnetic compounds.** Erkelens, W.A.C. (Rijksuniversiteit Leiden (Netherlands)). 30 Sep 1987. 162p. NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS. Order Number DE88706063/JAW.

Includes Dutch summary.

First, some theoretical aspects of neutron scattering techniques are given, and the cyrogenic equipment and the neutron spectrometers employed are described. Experiments on a 3-d Ising system are described, performed at very low temperatures and in a magnetic field. Experimental proof has been obtained for the theoretical prediction that the critical behaviour of a d-dimensional Ising system in a transverse magnetic field near T=0 is identical to that of a d+1 dimensional Ising system as a function of temperature in zero field. Experiments are described on a Ni/sup 2+/ compound which represents a good example of a 1-d antiferromagnetic Heisenberg (HAF), spin s=1, system. The results give evidence for the so called 'Haldane conjecture', a theory which predicts that the ground state of HAF systems with integer spin is a nonmagnetic many-body singlet. The excited states are separated from the ground state by an energy gap. Contrastingly, half-integer spin systems are predicted to have no such gap. A short introduction is given to phenomena in rare earth, 4f compunds, like the Kondo effect and heavy fermion behaviour. Experimental results on the RE hexaborides are reported, among which CeB/sub 6/, a typical Kondo system with complex magnetic orderings. Furthermore, inelastic neutron scattering experiments on NdB/sub 6/ and CeB/sub 6/, performed in order to get insight in the various reaction mechanisms, are presented. Finally a report is given on magnetic correlations and excitations in two nonmagnetically ordered heavy fermion compounds, CeCu/sub 6/ and CeRu/sub 2/Si/sub 2/ and their interpretation in the light of existing theories. 201 refs.; 61 figs.; 4 tabs.

23703 **(IRE—339(1987)) Kinetic effects of strong localization in planar heterostructures p-Ge/i-GaAs.** Mironov, O.A.; Chistyakov, S.V. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki). 1987. 42p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706205/JAW.

Galvanomagnetic properties of epitaxial germanium films forming a part of planar heterostructure are investigated experimentally. In the frames of percolation theory of Efros and Shklovsky the nature of anomal effects of the current-transfer is explained which were observed in the temperature range of 300 K - 1.5 K and in magnetic fields till 70 kOe. A prevail influence on electrophysical parameters of films p-Ge degree of disordering of the crystal structure depending on the temperature of sublayer at epitaxy has been found out. The investigations allowed to suggest a new thinfilm temperature sensor of the resistive type for cryogenics. 51 refs.; 12 figs.; 2 tabs.

23704 **(KAERI/RR—564/86) Study of nuclear materials by neutron scattering.** Kim, Huhn Jun; Chun, Byung Chil; Lee, Chang Hee; Koh Wook Hee; Lee, Jeong Soo; Seong, Baek Seok; Ho, Jong Wha. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Jan 1987. 88p. (In Korean). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705861/JAW.

For the study of texture in orthorhombic system materials, pole figures of uranium specimens were measured using neutron diffraction and their quantitative analysis were made by developing computer code TEXFBI based on Bunge formalism during '84-'85. In the analysis, a method to resolve composite pole figure was tried to increase maximum number of input pole figures and ODF series expansion terms. However, it has been found that the constrain conditions on mixing coefficients(q/sub ij/) are not properly satisfied during iteration and the result is dependant on strating q/sub ij/ values. To solve this problem, starting q/sub ij/ values are computed based on crystallograpic data and instrumental resolution and the steepest descent method is used for computation. This method can improve average error for pole figure(p) up to 0.23% for hot-rolled uranium specimen (600-650 deg C, texture index: J=4.8) when analyzed with I/sub p/=10 and L=16, as a typical example. The configuration of 7 horizontal beam tubes has been determined around KMRR core, 4 standard type beam tubes, 1 cold neutron beam tube, 1 irradiation study beam tube, and 1 neutron radiography beam tube, and evaluation of neutron field characteristics at the nose of these beam tubes is made. Design works for optimum beam tube shapes, structures, and auxillary facilities such as inpile collimators and rotating beam shutters etc. are in progress along with preparations for the basic design of neutron spectrometers to be installed at the beam tubes.

23705 **(RISO-M—2737) Phases of Pb/Ge(111): A surface X-ray diffraction study.** Grey, F. (Risoe National Lab., Roskilde (Denmark)). Mar 1988. 82p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757389/JAW.

This report describes the results of several surface X-ray diffraction measurements of a chemisorbed overlayer of Pb on the Ge(111) surface. Three phases of Pb/Ge(111) exist in the monolayer regime: the α- and β-phases with a $\sqrt{3}x\sqrt{3}R30$/sup 0/ unit cell, and a high-temperature 1x1 phase. In the 1x1 phase of Pb/Ge(111), isotropic X-ray scattering is observed consistent with a two-dimensional liquid phase. Measurements of the integer-order Bragg reflections through the $\sqrt{3}x\sqrt{3}R30$/sup 0/->1x1 transition confirm the liquid-like nature of the 1x1 phase, and show that the liquid layer is modulated by the periodic potential of the substrate. By measuring variations of the (2/3,2/3) surface Bragg reflection from the $\sqrt{3}x\sqrt{3}R30$/sup 0/ phase as a function of temperature and coverage, a simple phase diagram for Pb/Ge(111) is deduced. Below 1/3ML (where 1 ML is one Pb atom per Ge surface atom) the α-phase coexists with the 1x1 phase. Between 1/3ML and 4/3ML, α- and β-phases form a two-phase system displaying phase separation. Analogies with simple theoretical phase diagrams are emphasized. (orig.) With 11 tabs., 40 figs., 67 refs.

23706 **Model of metallic cohesion: The embedded-atom method.** Daw, M.S. (Sandia National Laboratories, Livermore, California 94550). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 11, 7441-7452(15 Apr 1989).

The embedded-atom method (EAM) [Phys. Rev. B 29, 6443 (1984)] has proven to be a significant improvement in simplified total-energy calculations for metallic systems. In the current work, the ansatz used in the EAM is derived from the local-density functional for the energy. The expression demonstrated here is most appropriate for simple metals and for transition metals with nearly empty or nearly full d bands. An embedding energy is defined as a function of an optimal constant background density, and an equation for that optimal background density is obtained. The cohesive energy is then related to the embedding energy and an electrostatic two-body interaction. It is shown that lowest-order electronic relaxations can be absorbed into the same ansatz. Model calculations are presented for fcc nickel within the Thomas--Fermi--Dirac--von Weizsaecker model for the kinetic energy, with local exchange and correlation and frozen-electron distributions. The model is shown to provide a good description of the ground-state properties of nickel (e.g., energetics and structure of vacancies and surfaces) and also a good framework for evaluating the approximations used in justifying the EAM form. In particular, the model exhibits a simple relationship between the optimal constant background density and the background density at the atomic site. Corrections involving the gradient of the background density are shown to be important in the calculation of the surface energy. This work then provides a basis for the use of the EAM in semiempirical applications.

23707 **Exact solution of a quantum electron-phonon system for a two-site periodic cluster.** Proetto, C.R.; Falicov, L.M. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 11, 7545-7551(15 Apr 1989).

The ground state of a one-dimensional electron-phonon system is studied by means of a small-crystal approach: an exact solution of a two-site cluster with two electrons and periodic boundary conditions. A single electron band is considered in the tight-binding approximation, together with two-electron interactions between electrons in the same site (Hubbard model); the electrons are coupled to longitudinal-acoustic phonons through a bilinear interaction. The problem is isomorphic with that of the homopolar diatomic molecule with a vibronic degree of freedom and coupling between the electronic and vibronic modes. In the adiabatic (large-ionic-mass, small-vibrational-frequency) limit there is an analytical solution which indicates that the transition between the nondistorted (weak-coupling) and the distorted (strong-coupling) phases can be either continuous or discontinuous, depending on whether the value of electron-electron interaction is smaller or larger than a critical value. In the extremely-high-frequency limit (ionic mass $M \to 0$) it is also possible to find an analytical solution (for $M = 0$) that shows that the system remains undistorted for any value of the electron-phonon coupling and the electron-electron interaction. In the intermediate case (finite, nonvanishing M), numerical solutions exhibit a continuous transition from the nondistorted to the distorted phase.

23708 **Pseudospherical integration scheme for electronic-structure calculations.** Averill, F.W.; Painter, G.S. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 12, 8115-8121(15 Apr 1989).

Contemporary electronic-structure methods avoid shape approximations but in doing so encounter the difficult problem of integral evaluation over complicated interstitial volumes. In this paper, we present a simple and efficient technique for applying rapidly convergent Gaussian product formulas to general interstitial regions. Like the recent methods of Boerrigter, te Velde, and Baerends, it is based upon partitioning space into Voronoi cells and atomic spheres. In the present work, introduction of a general pseudospherical local-coordinate system unifies the integration procedures and effects a simplified approach. A systematic procedure is derived for determining the number of Gaussian points required for a specified level of numerical precision.

23709 **Applications of the quadratic Korringa-Kohn-Rostoker band-theory method.** Nicholson, D.M.; Faulkner, J.S. (Metals and Ceramics Division, Oak Ridge National Laboratory, P.O. 2008, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 12, 8187-8192(15 Apr 1989).

Comparisons with other calculations in the literature are used to demonstrate that the quadratic Korringa-Kohn-Rostoker band-theory method gives excellent eigenvalues for full self-consistent potentials with no shape approximation. The equations for the Green function are reformulated, thus eliminating a problem that had hampered calculations of self-consistent potentials and total energies with the use of this method.

23710 **Electron scattering by atomic chains: Multiple-scattering effects.** Xu, M.; Barton, J.J.; Van Hove, M.A. (Center for Advanced Materials, Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 12, 8275-8283(15 Apr 1989).

Multiple-scattering effects of electrons traveling along atomic chains are shown to be important and useful for surface structure determination, especially in the medium-energy range (200--1000 eV). This applies to techniques based on diffraction of elastic electrons, such as medium-energy electron diffraction, as well as to techniques based on the angle-resolved detection of "secondary" electrons such as photoelectrons, Auger electrons, and other electrons. Two new methods for computing multiple-scattering amplitudes for chains are derived and used to show how multiple scattering along chains of atoms produces focusing, defocusing, amplification, and layer-dependent enhancements that can be put to effective use in structure determination. Strong forward-focusing peaks along internuclear axes are dominant under many conditions: this is a single-scattering effect. However, multiple scattering can totally defocus such forward-focused peaks, while other interference effects produce additional scattering peaks that do not have the direction of an internuclear axis. In addition, it follows that surface composition analysis by conventional Auger-electron spectroscopy can be quite sensitive to the incident direction of the electron beam used to produce Auger emission.

23711 **"Hall crystal" versus Wigner crystal.** Tes-hacekanovic, Z.; Axel, F.; Halperin, B.I. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 12, 8525-8551(15 Apr 1989).

We consider the possibility of coexistence of the quantized Hall effect (QHE) and a weak charge-density wave. For suitably chosen interactions between the fermions, there is a crystalline ordered state ("Hall crystal") exhibiting QHE. Unlike the standard Wigner crystal, the energy of the Hall crystal does not have a cusp minimum when the fermion density is precisely an integer per unit cell of the structure. The density is locked onto a multiple of the magnetic flux density, while the period of the charge-density wave can vary continuously. The normal modes of the Hall crystal show separate transverse and longitudinal modes, with linear dispersion at long wavelengths. We propose a model for which the Hartree approximation is accurate and which exhibits a Wigner-crystal phase, a Hall-crystal phase, and a translationally invariant quantized--Hall--"liquid" phase, as the coupling constant is varied. We study the one-particle band structure and its associated Diophantine equations, the Hall conductance, and the normal modes of this model, in its various regimes, exploiting the existence of two topological invariants (Chern numbers) which characterize the system. We also examine the transitions between different phases.

23712 **Doping-induced suppression of dislocation formation in semiconductors.** Walukiewicz, W. (Center for Advanced Materials, Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 12, 8776-8779(15 Apr 1989).

A mechanism explaining suppression of dislocation formation in doped semiconductors is proposed. The mechanism is based on the recently introduced concept of amphoteric native defects. It is shown that supersaturation of vacancylike defects depends on the Fermi energy and thus also on the doping level. The calculated dependence of supersaturation on the doping level quantitatively accounts for experimentally observed trends in dislocation suppression in GaAs and InP.

23713 **Emission of convoy electrons after grazing ion-surface collisions.** Winter, H.; Strohmeier, P.; Burgdoerfer, J. (Institut fuer Kernphysik der Universitaet Muenster, Wilhelm-Klemm-Strasse 9, D-4400 Muenster, West Germany). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 8, 3895-3901(15 Apr 1989).

Convoy electrons emitted in collisions of 100--340-keV protons with a Si(111) surface at grazing incidence are investigated. The observed cusp shape in the electron spectra is significantly broadened in comparison to that observed in ion-atom and beam-foil interaction. We attribute this broadening to a deviation from the Coulombic final-state interaction near the surface due to the image potential.

23714 **Forward electron production in antimatter-solid collisions.** Burgdoerfer, J.; Wang, J.; Mueller, J. (Department of Physics, University of Tennessee, Knoxville, Tennessee 37996-1200 and Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6377). *Physical Review Letters;* **62**: No. 14, 1599-1602(3 Apr 1989).

We investigate the forward electron emission induced by fast antiprotons transmitted through thin carbon foils. The capture of electrons into wake-riding states is calculated in the second Born approximation. The transport through the foil is analyzed within

the framework of classical stochastic dynamics. We find evidence that the usual cusp-shaped peak for positively charged ions is replaced by a broad peak due to emission of wake-riding electrons.

23715 **Comment on "Low-temperature properties of the two-impurity Kondo Hamiltonian".** Rasul, J.W.; Schlottmann, P. (Department of Physics, Temple University, Philadelphia, Pennsylvania 19122). *Physical Review Letters;* **62**: No. 14, 1701-1701(3 Apr 1989).

A Comment on the Letter by B. A. Jones, C. M. Varma, and J. W. Wilkins, Phys. Rev. Lett. 61, 125 (1988).

23716 **Thue-Morse quantum Ising model.** Doria, M.M.; Nori, F.; Satija, I.I. (Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 10, 6802-6806(1 Apr 1989).

We study the one-dimensional quantum Ising model in a transverse magnetic field where the exchange couplings are ordered according to the Thue-Morse (TM) sequence. At zero temperature, this model is equivalent to a two-dimensional classical Ising model in a magnetic field with TM aperiodicity along one direction. We compute the order parameter (magnetization) of the chain and the scaling behavior of the energy spectrum when the system undergoes a phase transition. Analogous to the quasiperiodic (QP) quantum Ising chain, the onset of long-range order is signaled by a nonanaliticity in the exponent δ which describes the scaling of the total bandwidth with the size of the chain. The critical spin-coupling can be computed analytically and it is found to be lower than the QP case. Furthermore, the energy bands are found to be narrower than the corresponding QP chain. The former and latter results are consistent with the fact that the present structure has a degree of ordering intermediate between QP and random.

23717 **Time evolution of the nonadiabatic nonlinear quantum dimer.** Kenkre, V.M.; Wu, H. (Department of Physics and Astronomy, University of New Mexico, Albuquerque, New Mexico 87131). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 10, 6907-6913(1 Apr 1989).

We analyze the set of coupled equations which describe the strong interactions between a moving quasiparticle in a solid and vibrations of the solid responsible for self-trapping and other polaronic and solitonic phenomena. The goal of the investigation is the examination of novel effects, if any, of relaxing the traditional (adiabaticity) assumption of disparate time scales for the quasiparticle motion and the vibrations. The study uncovers several striking phenomena including an approach to the self-trapped stationary states of the adiabatic dimer and the coexistence of a static and a dynamic transition in the behavior of the quasiparticle motion.

23718 **Spin-fluctuation resonance in mixed-valence materials.** Liu, S.H. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6032). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 10, 7381-7383(1 Apr 1989).

We analyze the neutron magnetic form factor of a lattice of fluctuating spins when the narrow band of resonance levels is partially occupied. The form factor is predominantly that of the conduction electrons at the Fermi level. This result shows that spin fluctuation is not the sole source of heavy electrons in a number of mixed-valence and heavy-electron systems, which have been shown experimentally to have f-electron form factors in the Fermi-liquid phase. A resolution of this dilemma is proposed and the proper place where the spin-fluctuation theory applies is identified.

23719 **Phase diagram of the two-dimensional negative-U Hubbard model.** Scalettar, R.T.; Loh, E.Y.; Gubernatis, J.E.; Moreo, A.; White, S.R.; Scalapino, D.J.; Sugar, R.L.; Dagotto, E. (Department of Physics, University of Illinois, Urbana, Illinois 61801). *Physical Review Letters;* **62**: No. 12, 1407-1410(20 Mar 1989).

Theoretical arguments and numerical calculations are used to discuss the phase diagram of the two-dimensional negative-U Hubbard model. Our results are consistent with (1) a vanishing transition temperature at half-filling but with a ground state having both superconducting and charge-density-wave long-range order, and (2) a Kosterlitz-Thouless transition at a finite temperature into a superconducting state with power-law decay of the pairing correlations away from half-filling.

23720 **Direct observation of polarization mixing in nuclear Bragg x-ray scattering of synchrotron radiation.** Siddons, D.P.; Hastings, J.B.; Faigel, G.; Berman, L.E.; Haustein, P.E.; Grover, J.R. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **62**: No. 12, 1384-1387(20 Mar 1989).

The direct observation of polarization mixing in nuclear Bragg scattering of synchrotron radiation by α-/sup 57/Fe''_2O_3 is reported. Application of a magnetic bias field having the appropriate orientation was shown to produce almost complete rotation of the σ-polarized incident beam to a π-polarized diffracted beam. Rotation of this field about the diffraction vector through 90° caused the diffracted beam polarization to change continuously from σ through elliptical to π, as predicted theoretically.

23721 **Vibrational properties of epitaxial films on metals. II. fcc Ni on the Cu(001) surface.** Chen, Y.; Wu, Z.Q.; Yao, J.M.; Tong, S.Y. (Department of Physics and Laboratory for Surface Studies, University of Wisconsin--Milwaukee, Milwaukee, Wisconsin 53201). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 9, 5617-5622(15 Mar 1989).

The general vibrational properties of epitaxially grown fcc Ni film on the Cu(001) surface have been studied using a central-force lattice-dynamical slab model. We found that, since the force constant in the overlayer film is different from that of the substrate, the surface-phonon modes may merge into the substrate bulk-phonon band, and a strong hybridization between the surface phonons and the bulk modes may take place. The theoretical phonon dispersion curves and the spectral densities are presented, and new film modes have been identified.

23722 **Random-deposition models for thin-film epitaxial growth.** Evans, J.W. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 9, 5655-5664(15 Mar 1989).

The simple on-top site random-deposition model for film growth on a simple-cubic (100) substrate is extended to other adsorption-site geometries and crystal structures. Nontrivial statistical correlations within the growing film typically result. However, the master equations can be solved exactly to elucidate, e.g., growth kinetics, Bragg intensity (I/sub Br/) behavior for surface diffraction, and spatial correlations within the film. Other techniques facilitate analysis of the percolative structure of intralayer islands. For random deposition at fourfold hollow sites on a face-centered cubic (100) substrate, despite the absence of diffusion, there are distinct I/sub Br/ oscillations similar to those observed experimentally during deposition of Pt on Pd(100) at low temperature.

23723 **Fractal geometry of collision cascades.** Rossi, F.; Parkin, D.M.; Nastasi, M. (Center for Materials Science, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Materials Research;* **4**: No. 1, 137-143(Jan 1989).

The fractal nature of self-ion collision cascades is first described using an inverse power potential and then by the more realistic potential of Biersack--Ziegler. Based on the model of Cheng et al. and TRIM Monte Carlo simulations, the average cascade fractal dimension is a function of both atomic mass and initial energy. The instantaneous fractal dimension increases as the cascade evolves. A critical energy E/sub c/ for producing a dense subcascade is derived and it is shown that E/sub c/ agrees well with the onset energy for constant damage efficiency.

6561 Superconductivity

REFER ALSO TO CITATION(S) 22516, 22519, 22521, 22527, 22553, 22554, 22555, 22566, 22570, 22571, 22574, 22575, 22577, 22579, 22580, 22581, 22583, 22628, 22630, 23719

23724 **(BNL—42265) Neutron scattering studies of magnetic excitations in La/sub 2-x/Sr/sub x/CuO_4.** Kastner, M.A.; Aharony, A.; Birgeneau, R.J.; Endoh, Y.; Fukuda, K.; Gabbe, D.R.; Hidaka, Y.; Jenssen, H.P.; Murakami, T.; Oda, M. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 14p. (CONF-8808138—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008155/JAW.

From International conference on the electronic structure of high Tc symposium; Rome, Italy (1 Aug 1988).

The results of recent neutron scattering studies on La/sub 2-x/Sr/sub x/CuO_4 are reviewed. For x = 0 the material is an antiferromagnetic insulator, and the spins in the CuO_2 sheets are well-described by the 2D S = 1/2 square lattice Heisenberg model. With increasing x the Neel state is destroyed and is replaced at low temperatures, at least for samples which are nonmetallic or have low superconducting T/sub c/'s, by a spin glass. The instantaneous correlations as well as those of the glass are incommensurate with the crystal lattice. The spin-spin correlation length in the doped CuO_2 sheets equals the average separation between the holes which ultimately carry the supercurrent. 47 refs., 7 figs.

23725 (JINR—N-1-27-88, pp 12-17) **Positron annihilation in a high-temperature superconductor YBa/sub 2/Cu/sub 3/O/sub 7-δ/.** Vavryshchuk, Ya.; Levandovski, M.; Rybakov, V.N.; Yutlandov, I.A.; Goworek, T.; Mazurek, P.; Ivanov, A.I.; Uchevatkin, I.F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Uniwersytet Marii Curie-Sklodowskiej, Lublin (Poland). Inst. Fizyki; Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Metrologii, Leningrad (USSR)). 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01; INIS. Order Number DE89780078/JAW.

In JINR rapid communications. Collection.

Positron annihilation as a function of temperature in high-temperature superconductors YBa/sub 2/Cu/sub 3/O/sub 7-δ/ has been investigated. It is shown that a change in the annihilation capacity at the transition into superconducting state is relatively small. The change of r/sub 1/ and r/sub 2/ positron lifetimes as well as of the intensity of the component with r/sub 2/-J/sub 2/ and Doppler broadening S parameter allows one to assume that transition into superconducting state is accompanied with a certain decrease in electron density and with decreasing number of defects or increasing size of crystalline net. 9 refs.; 1 fig.

23726 (JINR—N-2-28-88, pp 28-32) **Stabilization of high-temperature supeconductor Y/sub 1/Ba/sub 2/Cu/sub 3/O/sub 7-δ/ surface.** Korenev, S.A.; Valentovich, D.; Lushchikov, V.I. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780079/JAW.

In JINR rapid communications. Collection.

A technique is suggested for stabilization of a high-temperature superconductor Y/sub 1/Ba/sub 2/Cu/sub 3/O/sub 7-δ/ surface by means of a high-current pulsed electron beam (J=12.5-65 A/cm/sup 2/, E=70-200 keV, t=300 ns, P=0.001 Pa). The quality of the remelted surface film is characterized and first experimental results are discussed. It is shown that within 50 days after the electron beam processing, no dielectric film was developed at the superconductor surface and superconductor characteristics did not change. 6 refs.; 4 figs.

23727 (JINR—N-2-28-88, pp 33-36) **Effect of isotope copper substitution on critical temperature of high temperature ceramics Y/sub 1/Ba/sub 2/Cu/sub 3/O/sub 7/.** Vasil'ev, B.V.; Lushchikov, V.I.; Sikolenko, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; Moskovskij Gosudarstvennyj Univ. (USSR)). 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780079/JAW.

In JINR rapid communications. Collection.

An isotope effect has been searched for in high-Tc superconductor Y/sub 1/Ba/sub 2/Cu/sub 3/O/sub 7/ through substitution of /sup 63/CU for /sup 65/Cu. No shift in the superconducting transition temperature is observed by electrical resistivity measurement. 7 refs.; 1 fig.

23728 **(RISO-M—2756) Superconductivity. Lecture notes of basic courses.** Andersen, N.H.; Mortensen, K. (Risoe National Lab., Roskilde (Denmark). Physics Dept.; eds.). (Risoe National Lab., Roskilde (Denmark)). Dec 1988. 243p. (CONF-8806233—). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88757390/JAW.

From Topsoe summer school on superconductivity; Risoe, Denmark (20 Jun 1988).

This report contains lecture notes of the basic lectures presented at the 1st Topsoee Summer School on Superconductivity held at Risoe National Laboratory, June 20-24, 1988. The following lecture notes are included: L.M. Falicov: 'Superconductivity: Phenomenology', A. Bohr and O. Ulfbeck: 'Quantal structure of superconductivity. Gauge angle', G. Aeppli: 'Muons, neutrons and superconductivity', N.F. Pedersen: 'The Josephson junction', C. Michel: 'Physicochemistry of high-T/sub c/ superconductors', C. Laverick and J.K. Hulm: 'Manufacturing and application of superconducting wires', J. Clarke: 'SQUID concepts and systems'. (orig.) With 10 tabs., 128 figs., 219 refs.

23729 (RISO-M—2756, pp 7-23) **Superconductivity: Phenomenology.** Falicov, L.M. (California Univ., Berkeley (USA). Dept. of Physics; Lawrence Berkeley Lab., CA (USA). Materials and Chemical Sciences Div.). Dec 1988. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88757390/JAW. (CONF-8806233—).

From Topsoe summer school on superconductivity; Risoe, Denmark (20 Jun 1988).

I. The superconducting state. (a) The superconducting transition temperature; (b) Zero resistivity; (c) The Meissner effect; (d) The isotope effect; (e) Microwave and optical properties; (f) The superconducting energy gap. II. The Ginzburg-Landau equations. (a) The coherence length; (b) The penetration depth; (c) Flux quantization; (d) Magnetic-field dependence of the energy gap; (e) Quantum interference phenomena; (f) The Josephson effect.

23730 (RISO-M—2756, pp 24-46) **Quantal structure of superconductivity. Gauge angle.** Bohr, A.; Ulfbeck, O. (Niels Bohr Inst., Roskilde (Denmark)). Dec 1988. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88757390/JAW. (CONF-8806233—).

From Topsoe summer school on superconductivity; Risoe, Denmark (20 Jun 1988).

The superconducting phase of the electron fluid arises through an instability of the fermi surface due to a weak, effective interaction between pairs of electrons close to the fermi surface. The instability leads to the formation of a static mean field, the pair field, which acts by adding and removing pairs of particles. The pair field thus constitutes a deformation in a new dimension, by which the symmetry associated with particle number conservation is spontaneously broken. The first lecture deals with simple aspects of the electron matter in the presence of the pair field (intrinsic motion). The deformation defines a direction angle, the gauge angle, conjugate to particle number, and the system thereby acquires the ability to rotate collectively in the new dimension. Moreover, the spatial variation of the gauge angle, by which local gauge invariance is spontaneously broken, manifests itself in the supercurrent. The second lecture addresses some general features of the collective degrees of freedom of the superconducting material, illustrating the effect of the symmetry breaking.

23731 (RISO-M—2756, pp 47-62) **Muons, neutrons and superconductivity.** Aeppli, G. (AT and T Bell Labs., Murray Hill, NJ (USA); Risoe National Lab., Roskilde (Denmark). Physics Dept.). Dec 1988. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88757390/JAW. (CONF-8806233—).

From Topsoe summer school on superconductivity; Risoe, Denmark (20 Jun 1988).

The principles of the neutron scattering and muon spin relaxation (μSR) techniques and their applications to studies of superconductors are described briefly. μSR and neutron scattering work on magnetic correlations in superconductors and materials directly related to superconductors are reviewed.

23732 (RISO-M—2756, pp 63-76) **Josephon junction.** Pedersen, N.F. (Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 1). Dec 1988. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88757390/JAW. (CONF-8806233—).

From Topsoe summer school on superconductivity; Risoe, Denmark (20 Jun 1988).

The basic equations for the Josephson junction are derived in a simple way. We discuss the properties of such junctions under various circumstances - including the effects of damping and capacitance - according to the shunted junction model. Also the effects of an external rf bias current are discussed; this leads to a definition of the various characterizing frequencies and to the appearance of many new phenomena. rf-applications such as SIS mixers and parametric amplifiers will be mentioned. The introduction of spatial dimensions leads to problems concerning cavity excitations and solitons. Finally conditions for the appearance of chaos in Josephson junctions will be discussed.

23733 (RISO-M—2756, pp 77-111) **Physicochemistry of high Tc superconductors.** Michel, C. (Laboratoire CRISMAT, 14 - Caen (France)). Dec 1988. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88757390/JAW. (CONF-8806233—).

From Topsoe summer school on superconductivity; Risoe, Denmark (20 Jun 1988).

The superconductivity discovered by Muller in the copper oxides is in agreement with this point of view since copper exhibits theorically two oxidation states simultaneously, Cu(II)- Cu(III). However the surprising feature is in the high value of the critical temperature of those oxides: Tc≃30-40 K in the Ba-La-Cu-O and Sr-La-Cu-O systems, Tc≃90 K in the Y-Ba-Cu-O system and related, Tc≃22 K and 80-110 K in bismuth compounds and Tc≃60-125 K in superconductors with thallium. For the theorists, these high values of the critical temperature is attributed in addition of the mixed-valence of copper, to the low dimensionality of their structures. So it may be an interesting way for the comprehension of the superconductivity in these compounds, to analyse their crystal chemistry in relation with the superconducting properties.

23734 **Investigation of current redistribution in superstabilized superconducting winding when switching to the normal resistive state.** Devred, A. (SSC Central Design Group, c/o UCLBL, MS 90-4040, One Cyclotron Road, Berkeley, California 94720). *Journal of Applied Physics;* **65**: No. 10, 3963-3967(15 May 1989).

We have investigated the electromagnetic behavior of a layer of superstabilized superconductive composite conductors when switching instantaneously and uniformly to the normal resistive state. The Laplace transform was used to solve the current diffusion equation in the superstabilizing material. The value of power dissipated per unit volume, averaged over the layer thickness, was then computed using the "pseudo"-convolution theorem in the complex plane. Last, we present a simple interpretation of the phenomenon with the help of two time constants.

23735 **Superconducting T/sub c/ enhancement due to negative-U impurities: Monte Carlo study of a local exciton model.** Schuettler, H.B.; Jarrell, M.; Scalapino, D.J. (Material Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 10, 6501-6513(1 Apr 1989).

The enhancement of superconductivity by a small concentration of excitonic negative-U centers is studied by a new method which combines diagrammatic perturbation theory and Monte Carlo simulation. Results are given which show how the impurity parameters should be selected in order to obtain the maximum increase in the superconducting transition temperature T/sub c/. We also discuss the underlying physics of these results.

23736 **Formation of a large singlet bipolaron: Application to high-temperature bipolaronic superconductivity.** Emin, D.; Hillery, M.S. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 10, 6575-6593(1 Apr 1989).

We variationally determine the conditions for the formation of large singlet bipolarons within the adiabatic approximation. We find that, in two- and three-dimensional electronic systems with only a short-range electron-lattice interaction, the only bipolarons are small bipolarons. Furthermore, with only the long-range (Froehlich) electron-lattice interaction characteristic of an ionic solid, we find the classical result that bipolarons will not form. However, with the presence of both short- and long-range components of the electron-lattice interaction, we find a novel domain within which large bipolarons can be formed. In particular, an exceptionally large ratio of the static to high-frequency dielectric constants, ϵ_0 and ϵ/sub ∞/, respectively, is critical to the formation of large singlet bipolarons. The remaining conditions for the formation of large singlet bipolarons are much less stringent for electronic systems of two dimensions than for those of three dimensions. Therefore, with the high-temperature superconductors having $\epsilon_0 >> \epsilon$/sub ∞/, the notion that their charge carriers are singlet large bipolarons is a real possibility. Estimating the transition temperature for bipolaronic superconductivity as the temperature of the Bose-Einstein condensation, transition temperatures of the order of those found in the high-temperature superconductors are reasonably obtained.

23737 **Fluctuations in granular superconductors.** Fishman, R.S. (Solid State Division, P.O. Box 2008, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6032). *Physical Review* [*Section*] *B: Condensed Matter;* **39**: No. 10, 7228-7231(1 Apr 1989).

By expanding the order parameter for an array of Josephson-coupled grains in powers of 1/z, where z is the number of nearest neighbors, I systematically incorporate the effect of phase fluctuations. The correction of order 1/z vanishes when the mean-field solution is known to be exact, for $\alpha = zJ/U = \infty$ and T/sup */ = T/zJ = 0. For larger T/sup */ and smaller α, the first-order correction increases until it diverges at the mean-field transition temperature.

23738 **Physical processing effects on polycrystalline YBa_2Cu_3O/sub x/.** Ford, W.K.; Anderson, J.; Rubenacker, G.V.; Drumheller, J.E.; Chen, C.T.; Hong, M.; Kwo, J.; Liou, S.H. (Department of Physics and the Advanced Materials Center, Montana State University, Bozeman, Montana 59717). *Journal of Materials Research;* **4**: No. 1, 16-22(Jan 1989).

The effect of heating YBa_2Cu_3O/sub x/ in vacuum to 600 °C has been studied using photoelectron spectroscopy and diamagnetic susceptibility measurements. Evidence of two chemically distinct copper and barium species is found in single phase samples at room temperature cleaned by gentle heating at 450 °C. Such annealing also increases the volume diamagnetic susceptibility of the samples which suggests that the preferred stoichiometry of growth does not lead to an optimum superconducting phase. Samples cleaned by vacuum scraping or ion bombardment reveal more amorphous XPS structure and are less indicative of bulk properties.

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REFER ALSO TO CITATION(S) 22518, 23313, 23328, 23523, 23547

23739 **(ATR—86A-8573-1) Thin-source concentration-dependent diffusion: A full solution.** Eng, G. (Aerospace Corp., El Segundo, CA (USA). Laboratory Operations). 19 Jun 1988. Contract AC02-76ER01198. 41p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009634/JAW.

A new method of analysis is developed for solving the problem of an initially thin source of impurity ions diffusing into a host solid, when the mechanism of transport involves a concentration-dependent diffusivity. In order to extract a diffusivity from experi-

mental data, we show that the fundamental experiment required is a measurement of the diffusion profile at two different times. The constant and the concentration-dependent contributions to the diffusivity then can be isolated by requiring the initial measured profile to propagate into the final measured profile. The analytical procedure presented here is shown to be a full solution to the problem of a diffusivity that varies linearly with concentration: D(C) = D/sub o/(1 + αC), where α is the strength of the nonlinear term. A matrix of orthogonal functions determines the time evolution for an arbitrary thin-source initial state. We show that the total diffusant amount is conserved, and that the solution is naturally expressed as a power series in α. The persistence of curvature on [ln(C) vs x^2] axes is then derived from the asymptotic (long-term) properties of the nonlinear equation solution. The solution up through order α^2 is then explicitly constructed for an arbitrary thin-source initial state. 66 refs.

23740 **(DOE/ER/13726—2) Fundamentals and techniques of nonimaging optics: Progress report, May 1988--January 1989.** Winston, R.; O'Gallagher, J. (Chicago Univ., IL (USA). Enrico Fermi Inst.). Mar 1989. Contract FG02-87ER13726. 12p. NTIS, PC A03 - OSTI. Order Number DE89008878/JAW.

Topics covered by the progress report are: flowline approach to nonimaging concentration; radiance and radiometry; and applications of nonimaging optics.

23741 (IC—88/163, pp 21-33) **Relation between relativistic and nonrelativistic solitons and kinks.** Baby, B.V.; Barut, A.O. Sep 1988. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE89780077/JAW.

In Nonlinear de Broglie waves.

The solutions of the nonlinear Klein-Gordon (KG) equations and nonlinear Schroedinger equations (NLSE) are usually dealt with separately. We study here some consequences of the simple observation that these equations and the corresponding solutions belong to the same family and the latter are the limiting cases of the former. This study leads to several new exact solutions for both the NLSE and nonlinear KG equations. 33 refs.

23742 **(IC—88/163) Nonlinear de Broglie waves.** (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1988. Vp. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE89780077/JAW.

Individual papers are processed separately for the data base. (DLC)

23743 **(ICEFIZ-FT—311-1987) Open quantum systems and the two-level atom interacting with a single mode of the electromagnetic field.** Sandulescu, A.; Stefanescu, E. (Institutul Central de Fizica, Bucharest (Romania); R and D Institute for electronic components, Bucharest, Romania). (Central Inst. of Physics, Bucharest (Romania)). Jul 1987. 30p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706160/JAW.

On the basis of Lindblad theory of open quantum systems we obtain new optical equations for the system of two-level atom interacting with a single mode of the electromagnetic field. The conventional Block equations in a generalized form with field phases are obtained in the hypothesis that all the terms are slowly varying in the rotating frame.(authors).

23744 **(IFIN-FT—316-1987) Possible generalization of the concept of symmetry in analytical mechanics.** Grigore, D.R. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering). Sep 1987. 22p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706162/JAW.

A theorem of Lee Hwa Chung suggests a possible generalization of the symmetry concept in classical mechanics. It is shown that the theory of Konstant-Souriau-Kirillov can be adapted to this more general case. The theory is illustrated with a number of exaples.

23745 **(IFIN-MC—19-1987) Balancing a matrix for calculation of eigenvalues and eigenvectors.** Moldovan, N. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering). May 1987. 8p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706045/JAW.

Parlett and Reinsch algorithm for general matrix balancing isrefined by adding after each iteration a new balancing of the last two row-column pairs taken into account.

23746 **(IFVE-OEIUNK/OMVT—88-3) Program for solving the Schroedinger equation for bound states.** Grudtsin, S.N.; Ryabov, A.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 22p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706166/JAW.

This paper contains the description of the program for solving the Schroedinger equation for bound states of two particles. For arbitrary potential V(r) it calculates the levels and wave functions for different quantum numbers n,L,S,J, and calculates all relativistic corrections for the levels found. This program is intended for meson spectroscopy researches in elementary particles physics. 9 refs.; 2 tabs.

23747 (INIS-BR—1441, pp 212) **Jost-like function class.** Tomio, L. (Pernambuco Univ., Recife (Brazil). Dept. de Fisica). 1986. (In Portuguese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88705764/JAW. (CONF-8605361—).

From 6. national meeting on intermediate energy physics; Pocos de Caldas, Brazil (5 May 1986).

23748 **(INIS-mf—11398) Stochastic mechanics and the Ehrenfest relations. Memorandum no. 628.** Beumee, J.G.B.; Rabitz, H.; Technische Univ. Twente - Princeton Univ. Collaboration. (Technische Hogeschool Twente, Enschede (Netherlands). Afdeling der Toegepaste Wiskunde; Technische Hogeschool Twente, Enschede (Netherlands). Afdeling der Toegepaste Wiskunde; Princeton Univ., NJ (USA). Frick Chemical Lab.). (International Atomic Energy Agency, Vienna (Austria)). May 1987. 10p. NTIS (US Sales Only), PC A02/MF A01 - OSTI. Order Number DE88706174/JAW.

The Ehrenfest relations in quantum mechanics maintain that the acceleration of the mean position of a particle in configuration space equals the expectation of the force acting on the particle. The proof of this equality depends on the form of the position and momentum operators. It is assumed that the position of this particle can be represented as a stochastic process and using a symmetric definition of the derivative within the expectation, it is demonstrated that the acceleration of the mean equals the expectation of the mean acceleration operator commonly found in stochastic mechanics. The subsequent requirement that this mean acceleration equals the force for every possible position of the particle reproduces the stochastic analog of the Newton equation introduced by Nelson in the theory of stochastic quantization. 12 refs.; 13 schemes.

23749 (INIS-SU—70, pp 12-14) **Partially diagonalized hamiltonians and Lie algebras.** Ushveridze, A.G. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780068/JAW.

Kratkie soobshcheniya po fizike.; no. 7.

In Experimental and theoretical physics. Collection.

Group properties of partially diagonalized hamiltonians in nonrelativistic quantum mechanics are studied. The Lie algebras are derived for two-dimensional and multi-dimensional of accurately and quasi-accurately solved quantum-mechanical models with different potentials. It is noted that supersymmetrical generalizations of Schroedinger equations are constructed by replacing the algebra by superalgebra and using Grassman variables in construction of differential forms. 4 refs.

23750 **(INP—1300/PM) On relational nature of geometry of microphysics.** Chylinski, Z. (Institute of Nuclear Physics, Krakow (Poland)). Nov 1985. 62p. (In Polish). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88706200/JAW.

A relativity principle and a curiosity of Galilei space-time is described. An internal space-time of R/sub 4/ relation is presented. Lorentz limit of R/sub 4/ geometry and a field theory is given. The sources of the effects of R/sub 4/ hypothesis are characterized. The completeness of quantum description is discussed. 32 refs. (A.S.).

23751 **(JINR—R-11-88-86) Program package for investigation of differential equations by the external form method.** Topunov, V.L.; Shvachka, A.B. (Moskovskij Gosudarstvennyj Pedagogicheskij Inst. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1988. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706258/JAW.

The algorithm to invesigate the symmetry properties of differential equation by the external form method and the corresponding code are presented. The code realises the algebra of differential forms and it is simple in use due to simplification of data input-output concerning the differential equation under investigation. As input the differential operator or the external form representation of initial equation may be used. The code is used to construct the system of determining equations which then is presented in a passive form. The symmetry group algebra for a given equation must be found by a user. The code usage is illustrated for a large amount of nonlinear equations such as Dirac equation, shallow water model equation, Prandtl equation and so on. 20 refs.

23752 **(LA-UR—89-304) A first collision source method that satisfies discrete S/sub N/ transport balance.** Alcouffe, R.E.; D'Dell, R.D.; Brinkley, F.W. Jr. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 10p. (CONF-890438—2). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006558/JAW.

From American Nuclear Society meeting; Santa Fe, NM, USA (9 Apr 1989).

The standard first collision source method is modified to include the angle-integrated, mesh cell balance equation. This modification produces a method that is fully consistent with our normal S/sub N/ balance which is essential for diagnostic purposes. The method is also second order in mesh refinements. Illustrative results are also presented in the paper. 3 refs., 5 figs., 1 tab.

23753 **(LA-UR—89-385) Possible evidence for non-Newtonian gravity in the Greenland ice gap.** Ander, M.E. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 4p. (CONF-8808145—29). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007746/JAW.

From Meeting of the Division of Particles and Fields of the American Physical Society (APS); Storrs, CT, USA (15 Aug 1988).

An Airy-type geophysical experiment was conducted down a 2 km deep hole in the Greenland ice cap in order to test for possible violations of Newton's inverse square law by making gravity measurements over a range of 213 m to 1460 m. A significant departure from Newtonian gravity was observed. This result can be explained by the existence of an attractive non-Newtonian component of gravity with a strength of about 3.4% that of Newtonian gravity at a scale of 1460 m. Unfortunately, we cannot completely, unambiguously attribute it to a breakdown of Newtonian gravity because we have shown that lateral density variations in the bedrock beneath the ice can cause such apparent departures. If such variations existed, they would have to be rather unusual but certainly no impossible. 8 refs.

23754 **(UCRL—97689) Special techniques used for time domain, three dimensional finite element modeling of electromagnetics.** Grant, J.B. (Lawrence Livermore National Lab., CA (USA)). Nov 1988. Contract W-7405-ENG-48. 9p. (CONF-890479—5). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007227/JAW.

From 7. international conference on finite element methods in flow problems; Huntsville, AL, USA (3 Apr 1989).

Accurate and reliable electromagnetic modeling codes, which may be specific or general purpose, help Lawrence Livermore National Laboratory carry out its research. However, a need for a three-dimensional coded prompted the development of a finite element code. MAXWELL3 is a general electromagnetic modeling code (solves the differential Maxwell equations in the time domain) allows arbitrary geometrical shapes for simulation regions. The finite element technique was chosen over the finite difference technique because of the boundary-conforming discretization of the former. This paper focuses on some of the techniques used to make 3D finite elements tractable in electromagnetics. Sample models are presented to illustrate some of the effects certain techniques, e.g., a free space boundary, have on the solution. 4 refs., 3 figs.

23755 **(UCRL—99865) General grid finite difference methods for time dependent electromagnetic problems in two dimensions.** Ray, S.L. (Lawrence Livermore National Lab., CA (USA)). Nov 1988. Contract W-7405-ENG-48. 9p. (CONF-890479—7). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007225/JAW.

From 7. international conference on finite element methods in flow problems; Huntsville, AL, USA (3 Apr 1989).

A new method for solving Maxwell's equations in the time domain on two-dimensional irregular grids has been developed. The method is based on finite-difference approximations to Ampere's and Faraday's laws in both their differential and integral forms. These difference approximations are derived, in part, using finite element notions of coordinate transformations and isoparametric function mapping. Key features of the general-grid method are that it is a direct generalization of the familiar, orthogonal grid finite-difference, time-domain technique and that it is more accurate than previous irregular grid methods. 5 refs., 6 figs.

23756 **(UCRL—100325-Pt.1) Irreversibility and molecular dynamics I.** Hoover, W.G. (Lawrence Livermore National Lab., CA (USA)). Jan 1989. Contract W-7405-ENG-48. 12p. (CONF-8904121—2-Pt.1). NTIS, PC A03 - OSTI. Order Number DE89008040/JAW.

From Supercomputing and third world supercomputer exhibition; Santa Clara, CA, USA (30 Apr 1989).

In this pair of papers I trace the development of Molecular Dynamics from its beginnings at Los Alamos to the present day. I emphasize the impact of recent developments on the problem of understanding irreversibility, as summarized in the Second Law of Thermodynamics. 43 refs., 15 figs.

23757 **(UCRL—100325-Pt.2) Irreversibility and molecular dynamics II.** Hoover, W.G. (Lawrence Livermore National Lab., CA (USA)). Jan 1989. Contract W-7405-ENG-48. 12p. (CONF-8904121—3-Pt.2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008042/JAW.

From Supercomputing and third world supercomputer exhibition; Santa Clara, CA, USA (30 Apr 1989).

In this second of a pair of papers I emphasize the impact of recent developments on the problem of understanding irreversibility, as summarized in the Second Law of Thermodynamics, and speculate on the applicability of these same ideas to quantum systems. 23 refs., 9 figs.

23758 **Actually, Eoetvoes did publish his results in 1910, it's just that no one knows about it...** Nieto, M.M.; Hughes, R.J.; Goldman, T. (Theoretical Division, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545 and Niels Bohr Institutet, University of Copenhagen, Blegdamsvej 17, 2100 Copenhagen Oe, Denmark). *American Journal of Physics;* **57**: No. 5, 397-404(May 1989).

Actually Eoetvoes did publish his results in 1910, but no one knows about it because it was added at the end of a geophysics paper published in the proceedings of an international conference. After a short review of Eoetvoes' life, this article reports how the first publication of the results of his famous experiment was "lost." This and other historical curiosities about his work are related to the current interest in his results and modern theories of quantum

gravity. The appendices explain how the Eoetvoes balance works and also describe the controversy over the modern reanalysis of Eoetvoes' results.

23759 **On pressure change occurring during gas mixing.** Chenoweth, D.R.; Paolucci, S. (Applied Mechanics Department, Sandia National Laboratories, Livermore, California 94550). *American Journal of Physics;* **57**: No. 5, 463-465(May 1989).

A pressure change results at thermal equilibrium when ideal gases initially having the same pressure, different temperature, and dissimilar molecular structure are mixed in a constant volume isolated reservoir. This pressure change does not arise from the gas mixing, but rather it results from a redistribution of energy between the translational and internal molecular motion. The conditions for the existence of an extremum in the pressure change are also given.

23760 **Optimization of physical data tables by simulated annealing.** Corey, E.M.; Young, D.A. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Computers in Physics;* **3**: No. 3, 33-37(May 1989).

A simulated annealing program, HMCTAB, has been developed to optimize equation of state data tables for use in large physics simulation codes. A cost function dependent on table error and table size is defined and is used to accept or reject randomly chosen table grid configurations. An annealing schedule reduces the "temperature" parameter and drives the grid configuration toward the optimum. The result is a much smaller table with acceptable error.

23761 **Integrable dynamical systems with hierarchy. II. Solutions.** Okubo, S. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Journal of Mathematical Physics (New York);* **30**: No. 5, 1043-1052(May 1989).

A semisystematic method of finding solutions that satisfy the zero Nijenhuis tensor condition with dual symplectic structure is developed. In this manner, a few solutions, including that of the Toda lattice, have been found. It is also shown that the general solution for the linear problem is intimately connected with nontriviality of the second cohomology group of solvable Lie algebras. Moreover, the case of the quadratic problem requires studies of an algebra involving the triple-linear product system.

23762 **Computer simulation of trails on a square lattice. I. Trails at infinite temperature.** Lim, H.A.; Meirovitch, H. (Supercomputer Computations Research Institute, Florida State University, Tallahassee, Florida 32306-4052). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 8, 4176-4185(15 Apr 1989).

A trail is a random walk on a lattice for which two bonds are not allowed to overlap. However, the chain may cross itself and one may associate with each such intersection an attractive energy epsilon-c. We study trails at infinite temperature $T = \infty$ (i.e., trails without attractions) on a square lattice using the scanning simulation method. Our results for the radius of gyration and the end-to-end distance strongly suggest (as do previous studies) that the shape exponent is $\nu = 0.75$, similar to that for self-avoiding walks (SAW's). We obtain significantly more accurate estimates than have been obtained before for the entropy exponent $\gamma = 1.350 +- 0.012$ and for the effective growth parameter $\mu = 2.720\ 58 +- 0.000\ 20$ (95% confidence limit). The persistence length is found to increase with increasing chain length N and the data fit slightly better an exponential function N/sup w/ where $w = 0.047 +- 0.009$ than a logarithmic one. Guttmann [J. Phys. A 18, 567 (1985)] has shown exactly that trails and SAW's on the hexagonal lattice at $T = \infty$ have the same exponents. Our results suggest that this is true also for the square lattice.

23763 **Computer simulation of trails on a square lattice. II. Finite temperatures and the collapse transition.** Meirovitch, H.; Lim, H.A. (Supercomputer Computations Research Institute, Florida State University, Tallahassee, Florida 32306-4052). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 8, 4186-4194(15 Apr 1989).

We study by the scanning simulation method trails on a square lattice at finite temperatures. This method constitutes a very efficient tool since it enables one to obtain results at many temperatures from a single sample generated at any given temperature. The tricritical temperature at which the collapse transition occurs is - epsilon-c/k/sub B/T/sub t/ = 1.086 +- 0.002. The tricritical exponents of the trail shape and its free energy are, respectively, ν/sub t/ = 0.569 +- 0.008 and γ/sub t/ = 1.133 +- 0.024 (95% confidence limits). They are equal within the error bars to the exact values of self-attracting self-avoiding walks (SAW's). However, the crossover exponent phi/sub t/ = 0.807 +- 0.005 is significantly larger than the exact value 0.423 of SAW's. We also carry out a detailed scaling analysis near T/sub t/ and demonstrate that the various properties scale as predicted by theory. At sufficiently low temperatures (T≦T/sub t/) the persistence length appears to be {similar←to}1.

23764 **Lyapunov partition functions for the dimensions of chaotic sets.** Ott, E.; Sauer, T.; Yorke, J.A. (Laboratory for Plasma Research and Departments of Electrical Engineering and of Physics, University of Maryland, College Park, Maryland 20742). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 8, 4212-4222(15 Apr 1989).

Multifractal dimension spectra for the stable and unstable manifolds of invariant chaotic sets are studied for the case of invertible two-dimensional maps. A dynamical partition-function formalism giving these dimensions in terms of local Lyapunov numbers is obtained. The relationship of the Lyapunov partition functions for stable and unstable manifolds to previous work is discussed. Numerical experiments demonstrate that dimension algorithms based on the Lyapunov partition functions are often very efficient. Examples supporting the validity of the approach for hyperbolic chaotic sets and for nonhyperbolic sets below the phase transition (q<q/sub T/) are presented.

23765 **Breakdown of the Boltzmann equation in cellular-automata lattice gases.** Ernst, M.H.; van Velzen, G.A.; Binder, P.M. (Institute for Theoretical Physics, Princetonplein 5, P.O. Box 80.006 3508 TA Utrecht, The Netherlands). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 8, 4327-4329(15 Apr 1989).

In lattice gases the Boltzmann equation is not valid at low densities, if the collision rules admit reflections of unlike particles because of long-lived correlated ring-type collisions. This is shown for a simple mixture, a Lorentz gas, by comparing theoretical and molecular dynamics results for the diffusion coefficient.

23766 **Linear response of phase-space trajectories to shearing.** Morriss, G.P.; Evans, D.J.; Cohen, E.G.D.; van Beijeren, H. (Research School of Chemistry, Australian National University, Canberra, Australian Capital Territory 2601, Australia). *Physical Review Letters;* **62**: No. 14, 1579-1582(3 Apr 1989).

The influence of the Lyapunov instability on a trajectory in phase space is investigated numerically for a Lennard-Jones fluid under a constant shear rate γ. The time dependence of the distance $d(t,\gamma;\Gamma)$ between two individual trajectories, starting at the same phase point Γ, but moving either with or without an imposed shear, can be described by $d(t,\gamma;\Gamma) = A\gamma \exp(t/\tau/\text{sub } L/)$, where tau/sub L/ is the inverse of the largest Lyapunov exponent of the system without shear. A possible explanation of this behavior and the consequences for the validity of linear-response theory are discussed.

23767 **Coherent propagation of Stokes light in a collisionally broadened three-level amplifier.** Herman, B.J.; Eberly, J.H.; Raymer, M.G. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 7, 3447-3463(1 Apr 1989).

We undertake a theoretical investigation of the coherent optical propagation of Stokes light in a collisionally broadened three-level Raman amplifier. The Stokes light consists of two distinct spectral components: off-resonance stimulated Raman scattering and on-resonance stimulated fluorescence, induced by collisional

transfer of population to a near-resonant intermediate state of the atomic system. Our model is based on the semiclassical Maxwell-Bloch formalism where the separation of the Stokes light into two components results in an expansion from the usual 9 to 13 atomic variables. We investigate the model both analytically and numerically. We point out the physical contributions to the simultaneous evolution of pump, fluorescence, and Raman light. We discuss the development during propagation of these separate pulses, emphasizing the nonlinear effects that lead to saturation.

23768 **Integrable dynamical systems with hierarchy. I. Formulation.** Okubo, S. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Journal of Mathematical Physics (New York);* **30**: No. 4, 834-843(Apr 1989).

It is shown that any model with the zero (generalized) Nijenhuis tensor, under some additional assumptions, will automatically satisfy the hierarchy equation with an infinite number of conserved quantities in involution. Especially, if there is a dual symplectic structure with zero Nijenhuis tensor, then there exist infinite numbers of Poisson brackets and of Lagrangians giving the same equation of motion. Toda lattice is one such example

23769 **Higher-order discretizations and the Metropolis step.** Gausterer, H.; Sanielevici, S. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *D: Particles and Fields;* **39**: No. 6, 1791-1794(15 Mar 1989).

We discuss higher-order discretizations of evolution equations, subjected to a Metropolis accept/reject step. We point out that the acceptance criterion imposes a nontrivial constraint on the discretization scheme. Two algorithms which satisfy this constraint are tested for chains of harmonic and anharmonic oscillators.

23770 **Finite-size effects on the f(α) spectrum of the period-doubling attractor.** Cosenza, M.G.; McCormick, W.D.; Swift, J.B. (Center for Nonlinear Dynamics and Department of Physics, University of Texas at Austin, Austin, Texas 78712). *Physical Review* [*Section*] *A: General Physics;* **39**: No. 5, 2734-2737(1 Mar 1989).

Quadratic maps are used to study the spectrum of singularities of the period-doubling attractor close to and at the onset of chaos. Finite approximations of the critical orbit have observable effects on the determination of f(α) which can be predicted by using the scaling properties of the attractor.

23771 **Structure of new minimal supergravity.** Ferrara, S.; Sabharwal, S. (CERN, Geneva, Switzerland; University of California, Los Angeles, California 90024). *Annals of Physics (New York);* **189**: No. 2, 318-351(1 Feb 1989).

We derive the gravitational multiplets of new minimal Poincare supergravity and obtain a tensor calculus which allows us to compute general matter couplings in arbitrary R-symmetric supergravity theories. In particular, we derive Chern-Simons multiplets and super topological invariants. The relevance of these results for the description of the effective interactions of the massless excitations of four-dimensional heterotic superstrings with N = 1 spacetime supersymmetry is stressed. copyright 1989 Academic Press, Inc.

23772 **Systematic derivative expansion of the adiabatic phase.** De SousaGerbert, P. (Center for Theoretical Physics, Laboratory for Nuclear Science, and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Annals of Physics (New York);* **189**: No. 1, 155-173(Jan 1989).

We present several methods for obtaining a derivative expansion for the adiabatic phase in quantum systems. We consider Hamiltonians of the form H(t) = H_0+R/sup i/(t)T/sub i/, where R/sup i/(t) are external parameters, T/sub i/ generate a simple three parameter Lie algebra and H_0 is an element of the center of the algebra. We identify the first correction to the classical adiabatic theorem as Berry's phase and compute the next two orders. In the course of the calculation we also reanalyze an example first studied by Berry and show that due to topological triviality Berry's phase for this system can be removed by a canonical transformation. copyright 1989 Academic Press, Inc.

23773 **Quantum nonlocality.** Stapp, H.P. (Univ. of California, Berkeley (USA)). *Foundations of Physics;* **18**: No. 4, 427-448(Apr 1988).

It is argued that the validity of the predictions of quantum theory in certain spin-correlation experiments entails a violation of Einstein's locality idea that no causal influence can act outside the forward light cone. First, two preliminary arguments suggesting such a violation are reviewed. They both depend, in intermediate stages, on the idea that the results of certain unperformed experiments are physically determinate. The second argument is entangled also with the problem of the meaning of physical reality. A new argument having neither of these characteristics is constructed. It is based strictly on the orthodox ideas of Bohr and Heisenberg, and has no realistic elements, or other ingredients, that are alien to orthodox quantum thinking.

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23774 **(INIS-SU—72) Thermonuclear synthesis. Scientific-technical collection.** (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1988. 74p. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Individual papers in this collection are separately indexed.

23775 **(UCRL—100194-Rev.1) Fusion: A necessary component of US energy policy: Revision 1.** Correll, D.L. Jr. (Lawrence Livermore National Lab., CA (USA)). 26 Jan 1989. Contract W-7405-ENG-48. 26p. (CONF-890182—1-Rev.1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008038/JAW.

From McGraw-Hill nuclear publication's forum on US energy policy and nuclear option; Washington, DC, USA (31 Jan 1989).

When formulating US energy policy, planners must ensure that the nation's security, economy, environment, and technological competitiveness are not compromised by failure to meet US electrical energy needs. Increased concerns over the greenhouse effect from fossil-fuel combustion mean that US energy policy must consider how electrical energy dependence on oil and coal can be lessened by conservation, renewable energy sources, and advanced energy options (nuclear fission, solar energy, and thermonuclear fusion). In determining how US energy policy is to respond to these issues, it will be necessary to consider what role each of the three advanced energy options might play, and to determine how these options can complement one another. This paper reviews and comments on the principal US studies and legislation that have addressed fusion since 1980, and then suggests a research, development, and demonstration program that is consistent with the conclusions of those prior authorities and that will allow us to determine how fusion technology can fit into a US energy policy that takes a balanced, long-term view of US needs. 17 refs.

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REFER ALSO TO CITATION(S) 23844, 23860, 23882

23776 **(ANL/FPP/TM—238) ITER equilibrium with bootstrap currents, lower hybrid current drive and fast wave current drive.** Ehst, D.A. (Argonne National Lab., IL (USA)). Mar 1989. Contract W-31109-ENG-38. 59p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009676/JAW.

A current drive system is proposed for the technology phase of ITER which relies on rf power and bootstrap currents. The rf/bootstrap system permits operation at high safety factor, and we consider the axial value to be q/sub a/ ≅ 1.9, which minimizes the need for seed current near the magnetic axis. Lower hybrid power ({approximately}30 MW) provides current density near the surface, ICRF ({approximately}65 MHz, {approximately}30 MW) fast waves generate current near the axis, and high frequency fast

waves ({approximately}250 MHz, {approximately}74 MW) supply the remaining current density. The system is not yet optimized but appears to offer great flexibility (ion heating for ignition, current rampup, etc.) with relatively inexpensive and well developed technology. 29 refs., 16 figs., 1 tab.

23777 **(CEA-R—5428) Technical description of the PHEBUS laser.** (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Dec 1987. 364p. (In French). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88757183/JAW.

The PHEBUS installation for laser-fusion activities consists of a laser composed of two power assemblies of neodymium doped glass, of 74 cm final diameter, capable of producing an output energy of the order of 20 kJ at 1.05 microns and 10 kJ at 0.35 or 0.53 microns for pulse durations of 1 to 6 nanosec. The laser alignment and diagnostics devices assure correct focusing of the beam on the target enable the functioning of the laser and the energy focused at each shot to be characterised. The laser beams are focused onto a target in the middle of an experiment chamber in which all the systems for diagnosing the plasma created during the interaction are coupled. A third laser system, of reduced power, is used essentially for X diagnostics of the plasma. A computerized command-control system controls the overall operation of the installation.

23778 **(CONF-890191—1) A method for comparison of local transport models with Tokamak experimental results.** Howe, H.; Uckan, N. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007836/JAW.

From Transport task force meeting; Austin, TX, USA (11 Jan 1989).

This paper illustrates a method for comparison of complex theoretical transport models with Tokamak database using a 1D transport code.

23779 **(CONF-890283—1) Fast wave current drive modeling for ITER.** Batchelor, D.B.; Jaeger, E.F.; Carter, M.D. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008239/JAW.

From ITER working session; Garching, F.R. Germany (20 Feb 1989).

The fast wave current drive could be a very attractive scheme for ITER. The two primary issues to be resolved are: Can an acceptable antenna be designed to produce a k/sub {parallel}/ spectrum with most power in the phase velocity range $+v/sub\ e/ < v/sub\ phase/ < +c$, and will the rf power be efficiently absorbed by electrons in the desired velocity range without unacceptable parasitic damping by fuel ions and α particles? To address these issues we have employed two models: a simple slab model which allows rapid comparison of various antenna designs and phasings and shows trends of obtainable current drive efficiency under various assumptions, and a 2D full-wave solution of the fast wave equations in tokamak geometry which gives power absorption and current drive profiles. This 2D code realistically models the launched antenna spectrum with radial focusing, includes toroidal eigenmode effects (multiple pass absorption) of present, and includes the effects of ion cyclotron harmonic and α particle damping. 9 refs., 5 figs.

23780 **(CONF-890302—16) Analysis of the ignition experiment IGNITEX.** Carrera, R.; Fu, G.Y.; Helton, J.; Hively, L.; Montalvo, E.; Ordonez, C.; Rosenbluth, M.N.; Tamor, S.; Van Dam, J.W. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007847/JAW.

From 16. European conference on controlled fusion and plasma physics; Venice, Italy (13 Mar 1989).

The realization of an ignition experiment in a laboratory will prove the scientific feasibility of controlled thermonuclear fusion. The fusion ignition experiment IGNITEX has the potential to produce and control a self-sustained fusion reaction with relative simplicity and low cost. Relevant plasma physics aspects of the experiment are analyzed in this paper. 1 ref., 1 fig., 1 tab.

23781 **(CONF-890302—17) Stability of local modes in low-aspect-ratio stellarators.** Garcia, L.; Carreras, B.A.; Dominguez, N. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008722/JAW.

From 16. European conference on controlled fusion and plasma physics; Venice, Italy (13 Mar 1989).

The studies of MHD stability properties of stellarator-type configurations are complicated by the three-dimensional (3-D) nature of the equilibrium of these configurations. Usually, the unstable modes are pressure-driven and very localized around the rational surface. The 3-D Mercier stability criterion for local instabilities is therefore adequate for most of the stability studies. The method has been implemented in different 3-D equilibrium codes and is widely employed in stability calculations for stellarators. We use an average method based on vacuum flux coordinates to study the equilibrium of low-aspect-ratio configurations. The specific vacuum flux coordinates ({rho},θ,{var←phi}) are those described by Boozer. The radial variable is {rho}, while θ and {var←phi} are, respectively, poloidal and toroidal-like angles. The Jacobian is D = B/sub v/³/{rho}B$_\theta$g/sub B/. The only vacuum magnetic field covariant component different from zero is B/sub {var← phi}/ = g/sub B/, while $B_0\pi${rho}² is the toroidal flux. 7 refs., 1 fig.

23782 **(CONF-890384—1) ITER density profile with pellet injection.** Houlberg, W.A. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008730/JAW.

From IAEA technical committee meeting on H mode physics; Gut Ising, F.R. Germany (20 Mar 1989).

Particle transport in multi-pellet fueled JET plasmas in being examined to help evaluate density profile behavior in ITER. Preliminary results of the JET analysis were reported at the IAEA Technical Committee Meeting on Pellets in October 1988. In sawtooth free JET discharges, the density profile evolution after injection of pellets can be modeled with the neoclassical Ware pinch and a diffusion coefficient that is small in the plasma core and increased sharply in the vicinity of the $q = 2$ surface. This model is applicable to both ohmic and central ICRF heated discharges. Some of the auxiliary heated plasmas show a more rapid central density decay that appears to be related to MHD activity observed in soft x-ray signals. In these discharges the density profile evolution can be modeled with a temperature dependent diffusion coefficient and the neoclassical Ware pinch. There is a strong correlation between the inferred local particle and heat transport coefficients in all discharges. Plasmas with non-central pellet penetration show no significant density peaking, consistent with the small Ware pinch term. These results appear to conflict with those reported for ASDEX. There it was found that sustained pellet injection during neutral beam and ICRF heating, with pellet penetration of only half the plasma radius, led to markedly peaked electron density profiles as well as high edge recycling, reduced sawtooth activity, central impurity radiation, enhanced density limit, and improved global energy confinement. Thus, the implications of these results for ITER are still highly speculative because of the lack of knowledge about scaling with machine parameters. The JET results suggest that relatively deep fueling may be required to significantly influence the density profile shape, while the ASDEX results imply that partial penetration may be sufficient. 20 figs.

23783 **(CONF-8708272—3) Toroidal stability in the tokamak.** Hender, T.C.; Hastie, R.J.; Robinson, D.C.; Charlton, L.A.; Holmes, J.A.; Carreras, B.A.; Lynch, V.E. (Oak Ridge National Lab., TN (USA)). [1989]. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008726/JAW.

From Workshop on theory of fusion plasmas; Varenna, Italy (24 Aug 1987).

We review some of the wide range of linear and non-linear calculations which have been undertaken with the FAR code. In particular, three applications for which a fully toroidal treatment of the problem is essential are presented: for very low shear (q {ap-

proximately} 1 for r {approx←lt} a/2) or slightly non-monotonic q-profiles the rapid growth rate ({approximately}100 μs), sharp stability boundaries, and non-linear saturated states are in good agreement with the experimental observations on JET; for q-profiles of the type measured on TEXTOR with q_0 {approximately} 0.7 and reduced shear near q = 1 the observed stability is consistent with a strongly stabilizing effect due to reducing the aspect ratio; and a strong stabilizing effect on the m = 2 mode due to the favorable average curvature in the tokamak has been demonstrated. In all three cases, the numerical results have been very favorably compared with analytic theory in the large aspect ratio limit, and the code has permitted extension of these results to the physically interesting regimes of tight aspect ratio and strong plasma shaping. In conclusion, the FAR code and similar toroidal initial value codes represent very powerful tools for studying toroidal MHD behavior. In conjunction with ideal free boundary MHD codes and high-n ballooning codes, a complete set of tools now exists for analyzing MHD stability. 40 refs., 5 figs.

23784 **(CONF-8810231—8) Pellet ablation and temperature profile measurements in TFTR.** Owens, D.K.; Schmidt, G.L.; Cavallo, A.; Grek, B.; Hulse, R.; Johnson, D.; Mansfield, D.; McNeill, D.; Park, H.; Taylor, G. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400;AC02-76CH03073. 6p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008924/JAW.

From IAEA technical committee meeting on pellet injection and toroidal confinement; Gut Ising, F.R. Germany (24 Oct 1988).

Single and multiple deuterium pellets have been injected into a variety of TFTR plasmas, including ohmically heated plasmas with wide range of electron temperatures, neutral beam heated plasmas at several NBI powers and high T/sub e/, post NBI plasmas. Pellet penetration into these plasmas was determined by measuring the pellet speed and duration of the H/sub α//D/sub α/ light emission during pellet ablation in the plasma. These penetration measurements are compared to the predicted penetration computed using the ablation model developed by Oak Ridge National Laboratory. The plasma density profiles before and after pellet injection are used to estimate the number of particles deposited in the plasma. The plasma particle increase compared to the estimated number of atoms in the pellet yields a measure of the fueling efficiency of pellets in TFTR. The ablation cloud parameters are discussed based on polychromater measurements of the H/sub α//D/sub α/ line emission from the neutral cloud surrounding the pellet. The electron temperature profile evolution after pellet injection is examined for the case of multiple pellet injection into an ohmically heated plasma. The ORNL pellet ablation code was used to compare measured pellet penetration depths with a theoretical model. The measured input parameters to the model are the electron density and temperature profiles, the neutral beam heating profile, the neutral density profile, the pellet size, pellet speed and pellet composition. The free parameter in the model is the thickness of the neutral cloud surrounding the pellet. This parameter is adjusted to arrive at a reasonable agreement between measured and calculated pellet penetration depths. The output of the model which is directly comparable to experiment is the calculated ablation rate. It is assumed that the broad-band H/sub α//D/sub α/ emission is proportional to the ablation rate.

23785 **(DOE/ER/52127—21) Oscillating field current drive in the reversed field pinch.** Scardovelli, R.A.U. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1987. Contract FG02-86ER52127. 181p. NTIS, PC A09/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008698/JAW.

Oscillating Field Current Drive (OFCD) was originally proposed as a means of maintaining a quasi steady-state plasma current in a RFP without building up the magnetizing flux threading the central hole of the torus. The MHD dynamics of OFCD is analyzed using a combination of a 1-D transport code, a linear resistive MHD stability model, and Kadomtsev nonlinear global reconnection model. Using Faraday's law, Ohm's law and on-axis regularity conditions, it is shown that m = 1 modes are necessary for current drive, within the resistive MHD model. A class of m = 1 tearing modes that nonlinearly generate poloidal flux (a necessary condition for current drive) has been identified. These modes are destabilized by off-axis current peaks. A scoping study of the F-θ space has been undertaken to determine quantitatively the effectiveness of this class of tearing modes as a current drive mechanism. Results indicate that equilibria do exist, in regions of the F-θ space that are easily accessible experimentally, that can yield significant amounts of poloidal flux generation without seriously deteriorating the confinement. A scenario of the OFCD oscillations has been developed in terms of the evolution of the safety factor profile, by considering the stability of the RFP to current-driven tearing modes. The alternating compression and expansion of the plasma during the oscillations have been associated to two different classes of m = 1 tearing modes: the compression to modes driven by off-axis current peaks, that genera poloidal flux; the expansion to instabilities driven by on-axis current peaks, that generate toroidal flux. 76 refs., 34 figs., 5 tabs.

23786 **(DOE/ER/53215—T1) Measurement of the distribution of fusion reactions by gamma-ray tomographic reconstruction: Final technical report, January 1987--December 1988.** Moses, K.G. (JAYCOR, Torrance, CA (USA). Plasma Technology Div.). 31 Jan 1989. Contract FG03-86ER53215. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009082/JAW.

In the remainder of this report, we summarize the work JAYCOR has performed over the past contract period of this project. We give a brief review of the gamma-ray tomography technique we are developing. A description of the detectors and the selection criteria are also presented, while a discussion of the detector tests and the results of those tests are discussed. A survey of the work performed previously on tomographic reconstruction is given, and the recent efforts on direct Fourier reconstruction is presented. Finally, we present the conclusions from this project. 6 refs., 5 figs.

23787 **(DOE/ER/53263—2) A quiver kinetic formulation of radio frequency heating and confinement in collisional edge plasmas.** Catto, P.J.; Myra, J.R. (Lodestar Research Corp., Boulder, CO (USA)). Jan 1989. Contract FG02-88ER53263. 47p. (LRC—89-3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009675/JAW.

The near fields in the collisional edge plasma of a radio frequency heated tokamak can cause one or more charged species to oscillate in the applied field with a quiver (or jitter) speed comparable to its thermal speed. By assuming the quiver motion dominates over drifts and gyromotion a completely new kinetic description of the flows in an edge plasma is formulated which retains Coulomb collisions and the relevant atomic processes. Moment equations are employed to obtain a description in which only a lowest order quiver kinetic equation need be solved to evaluate the slow time particle fluxes and current induced by the applied fields. The electron heating by collisional randomization of their quiver motion (inverse bremsstrahlung) is balanced by impact excitation losses since equilibration with the ions is too weak. A model plasma of electrons, neutrals, and a single cold ion species is considered to illustrate the utility of the quiver kinetic formulation. The model predicts local electrostatic potential changes and a local {rvec E}{times}{rvec B} convective flux that is of the same magnitude and scaling as would be predicted by Bohm diffusion. 30 refs.

23788 **(DOE/ET/51013—264) Radial ion transport in a nonaxisymmetric magnetic mirror.** Goodman, D.L. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Feb 1989. Contract AC02-78ET51013. 144p. (PFC/RR—89-2). NTIS, PC A07/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008760/JAW.

An experimental study of radial ion transport in a nonaxisymmetric magnetic mirror is presented. It is found that the ion confinement time perpendicular to the magnetic field is an order of magnitude shorter than predicted by classical and neoclassical theories, and that radial transport can be the dominant ion loss mechanism. Transport experiments are performed in hydrogen, helium and argon plasmas by measuring equilibrium radial profiles of plasma density, ionization source, end loss current, electric field, electron temperature and ion temperature. The radial profiles of the perpendicular diffusion coefficient (D{perpendicular}) are presented, and range from a radial average of ≃5 {times} 10^3 cm^2/sec for hydrogen to ≃2 {times} 10^4 cm^2/sec for argon. These coefficients

are a factor of ten larger than the maximum possible classical and neoclassical diffusion coefficients in all three gases. The effect of low frequency RF power in the ion cyclotron range on the radial ion transport rate is also investigated. RF power increases the ion perpendicular transport, which then becomes the dominant loss mechanism. With sufficient RF power, the ion perpendicular loss rate exceeds the ionization source, with a resultant loss of plasma equilibrium. Application of RF power increases the radial transport rate of plasmas with resonant ions, which are also heated by the RF waves, as well as plasmas whose ion cyclotron resonance is not inside the confinement region. The increased transport rate during application of RF power shows up as an increased D{perpendicular}. This indicates that the radial ion transport is due to a direct interaction between the ions and the RF field, rather than to radial profile changes or enhanced ambipolar potential which are other RF effects. The effect of RF power on plasma potential is also studied. 64 refs., 57 figs., 11 tabs.

23789 **(DOE/ET/53088—278) Dynamical transition to second stability in auxiliary heated tokamaks.** Fu, G.Y.; Van Dam, J.W.; Rosenbluth, M.N. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Mar 1989. Contract FG05-80ET53088. 39p. (IFSR—278). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009223/JAW.

A simple transport model is developed to study the dynamic evolution of an auxiliary heated tokamak plasma during the transition to a high-beta, ballooning mode second-stable equilibrium. The effect of the ballooning mode stability on the transport is incorporated by prescribing an enhanced thermal diffusion in the unstable region. The resultant highly nonlinear transport equation is solved numerically as an initial value problem, and also analytically by means of boundary layer theory. In particular, the auxiliary heating power P required for global transition of a flux-conserving tokamak plasma to the second stability regime is found to scale P {tau}/sub E/ {proportional←to} $\sqrt{\xi}$/sub max/, where ξ/sub max/ is the instability-induced thermal conductivity enhancement factor and {tau}/sub E/ is the confinement time in the ballooning stable regime. 25 refs., 9 figs.

23790 **(FRCEA-TH—114) Study of the ionization of sodium vapor in the presence of resonant laser radiation.** Carre, B. (Paris-11 Univ., 91 - Orsay (France)). Jun 1986. 341p. (In French). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88757204/JAW.

Ionization of a diffuse sodium jet, excited by laser radiation (D2 resonance), either continuous or pulsed, is studied by electron spectroscopy. Results show: associative ionization (AI) in the collision of two Na(3p) excited atoms; occupancy of highly excited nl states in energy association collisions of two Na(3p) followed by Penning collisional ionization (CI) in the system Na(nl) + Na(3p); heating of electrons by 1, 2, or 3 superelastic collisions with Na(3p). For both the excitation cases (continuous or pulsed source) analysis of experiment results leads to a description of the whole of the ionized medium, characterized as being low density and the site of the ambipolar diffusion of charged particles. A highly simplified model describes the kinetic and electrokinetic equilibrium (continuous case) in which the different populations of distinct nonthermalized energy (low energy primary electrons, hot electrons) play specific roles. The cross sections associated with AI and CI are estimated from experiment results using the model.

23791 **(FRCEA-TH—134) Study of noninductive current generation in a plasma.** Rax, J.M. (Paris-11 Univ., 91 - Orsay (France)). Jan 1987. 266p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88757351/JAW.

Three aspects of noninductive current generation are treated: (1) The kinetic problem, i.e., coupling between current-carrying energetic electrons on the one hand, and the electromagnetic wave and thermal particles on the other. (2). The electromagnetic problem, i.e., calculation of the wave structure produced by the antennas. (3) The study of nonthermal radiation and electrical responses. Green's functions are used to solve the kinetic problem. The electron distribution function is calculated. For the electromagnetic problem of wave structure at different wave numbers, the Green's function of the Maxwell equations in an inhomogeneous, anisotropic medium which is spatially and temporally scattered was calculated. Perturbation of propagation by diffusion and conversion was studied. The calculation of nonthermal radiation and of transfer of electromagnetic wave energy into magnetic energy is derived from the two preceding problems. A method to produce fusion power quasi-continuously using two inductively and thermally coupled tokamaks is proposed.

23792 **(IAE—4591/6) Approach to simulation of diffusion-type processes in quasicylindrical geometry using cubic splines.** Zhogolev, V.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706156/JAW.

The new mathematical approach to a simulation of diffusion-type one-dimensional transport processes is proposed in the paper. The approximate solution is seeked in the cubic splines class, unlike traditional differential methods. This makes it possible to obtain a good approximation on grids and to go over into a new grid on every time pitch. The grid motion in the course of calculations enables to keep track of the heavy gradient region, which permits to confine to a small number of points in solving nonlinear problems. The testing calculation results are given in the paper. The approach is oriented to be used in the 1.5 dimensional code for simulation of transport processesin a plasma filament with nested structure of magnetic surfaces. 7 refs.; 3 figs.

23793 **(IAE—4598/8) Ignition conditions in the CIT tokamak.** Merezhkin, V.G.; Mukhovatov, V.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706157/JAW.

Possibility of self-sustaining D-T-reactor in the CIT tokamak is analyzed on the basis of the T-11 scaling for the plasma energy confinement time and the T-11 model for the coefficients of electron thermal conduction and diffusion. Results of calculating plasma energy belance in the CIT, based on the transport model suggested in result of experiments in the T-11 tokamak are presented. Calculation results based on the T-11 model for the coefficients of electron thermal conduction and diffusion, testify to possibility of achieving ignition under joule CIT conditions at B/sub T/ ≃ 12T. Satisfactory agreement of results of numerical calculations according to the T-11 model with experimental data is noted far a wide range of conditions of joule heating and for the series of conditions with auxiliary heating. 30 refs.; 13 figs.

23794 **(ICEFIZ-LOP—60-1987) Correlation between the processes in the initial and final phases of the PF discharge and some means to influence this correlation.** Baltog, I.; Dumitrescu-Zoita, C.; Falie, D.; Mandache, N.; Mihut, L.; Zambreanu, V.; Zoita, V.; Borowiecki, M.; Czekaj, S.; Denus, S. (7041340RO). (Central Inst. of Physics, Bucharest (Romania)). Jun 1987. 18p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706161/JAW.

Phenomena occurring during successive stages of PF discharge and correlations between them where investigated on the IPF-2/20 device (20 kJ at 20 kV) by means of a number of diagnostic methods. (authors).

23795 (INIS-SU—71, pp 35-37) **Spatial amplification of oscillating perturbations of density during filamentation and Mandelshtam-Brillouin stimulated scattering in a plasma.** Shirokov, A.S. 1988. (In Russian). NTIS (US Sales Only), PC A03/MF A01; INIS. Order Number DE89780069/JAW.

Kratkie soobshcheniya po fizike.; no. 4.

In Experimental and theoretical physics. Collection.

A frequency range, where there exists spatial amplification of plasma density perturbations in an electromagnetic wave field, is found. At low frequencies perturbations growth is caused by filamentation, even stronger than in a stationary case. With the frequency increase there occurs transition from filamentation to Man-

delstam-Brillouin stimulated scattering, the maximum amplification corresponds to backside scattering. 6 refs.; 1 fig.

23796 (INIS-SU—72, pp 46-48) **Modelling the internal disruption in the tokamak plasma.** Bobrovskij, G.A.; Esipchuk, Yu.V.; Savrukhin, P.V.; Tarasyan, K.N. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Thermonuclear synthesis. Scientific-technical collection.

Internal desruption model, where the desruption begins at the critical value of the T/sub e/ relative gradient on the q=1 surface, is suggested. The desruption, as it is, represents the expansion process of the electron heat conductivity increased coefficient region. The suggested self-congruent model of the interval desruption describes satisfactorily its main characteristics and includes in fact only two free parameters. 7 refs.; 4 figs.; 1 tab.

23797 (INIS-SU—72, pp 55-59) **Study of two types of T-10 device regimes with ECR and ohmic heating.** Alikaev, V.V.; Bagdasarov, A.A.; Berezovskij, E.L. and others. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Thermonuclear synthesis. Scientific-technical collection.

The study of two types of T-10 regimes - with low impurity confinement (S-regime) and with enhanced one (B-regime) has been continued in deuterium discharges. In present experiments the transitions from S to B regimes were obtained by method of gas puff cutoff. Detail investigations of profile evolutions of T/sub e/(r), T/sub i/(r), n/sub e/(r) and carbon density n/sub C/ showed, that n/sub e/ profile greatly charges after gas puff cutoff, while T/sub e/(r) and T/sub i/(r) remain practically unchanged at the central zone of plasma. It pointed out to the possibility of a relation between n/sub e/(r) and either T/sub e/(r) or T/sub i/(r). It is shown, that the main cause which is responsible for this transition between B and S regimes, is variations of neutral atom influx to the plasma. The transition itself takes place at a given radius of plasma, when n/sub c/ reaches some limiting value at this radius. 11 refs.; 5 figs.

23798 (INIS-SU—72, pp 59-61) **Three-dimensional modeling the ion distribution function in a tokamak with ICR heating.** Belyanskaya, N.V.; Berezovskij, E.L.; Dnestrovskij, Yu.N.; Efremov, S.L.; Kostomarov, D.P.; Smirnov, A.P. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Thermonuclear synthesis. Scientific-technical collection.

3D-model of the IC-waves interaction with the hydrogen ions and of the ion convection in a corrugated magnetic field to tokamak is described. Results of the simulation are compared with the experimental ones. 4 refs.; 3 figs.

23799 (INIS-SU—72, pp 61-63) **Nonlocal transport in the scrape-off plasma in tokamak.** Igitkhanov, Yu.L.; Yushmanov, P.N. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Thermonuclear synthesis. Scientific-technical collection.

Even when the hydrodynamic approximation is satisfied on average, i.e., when the mean free path is much less than the characteristic longitudinal gradients, the expressions for the classical heat conductivity and viscosity coefficients turn out to be overestimated. This is due to the fact that the hydrodynamic heat and momentum fluxes are determined by the tail of the distribution function and become essentially nonlocal by nature. In the paper the Grad method is used to determine the transport structure. The integral expressions for the longitudinal heat and momentum fluxes are obtained. 5 refs.; 2 figs.

23800 (INIS-SU—72, pp 68-69) **Carbonization of the T-10 tokamak liner for ECR heating experiments.** Grashin, S.A.; Notkin, G.E.; Sokolov, Yu.A. and others. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Thermonuclear synthesis. Scientific-technical collection.

Carbonization of T-10 tokamak liner allowed the regimes with low inflow of high Z impurities to be carried out. Under these conditions the ECR heating experiments with level of power up to 4 MW were performed. The carbonization causes carbon films to be produced on the inner surface of the liner. The films obtained in glow discharges were 1000 A in thickness, amorphous and homogeneous. The majority of C atoms were bound by tetrahedral diamond-like type of bond. One-time preparation of T-10 chamber by carbonization method permitted to obtain as many as 300 pulses with fair reproducibility of plasma parameters. After the carbonization the radiation losses as well as inflows of impurities of iron became 2 - 3 times as low as before it. The recycling and upper limit of plasma concentration became higher. The energy and particles confinement in the filament plasma were affected by wall condition and near-wall plasma parameters. The regimes with poor impurities confinement and more effective ECR heating of plasma were carried out. 4 figs.

23801 (INIS-SU—72, pp 63-65) **Plasma study in the T-10 tokamak by reflected microwave signal.** Buzankin, V.V.; Vershkov, V.A.; Dreval', V.V.; Zhuravlev, V.A. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Thermonuclear synthesis. Scientific-technical collection.

Description and the testing results of two plasma investigation techniques by a reflected microwave signal in T-10 tokamak are given. The first is a radar modification and measures time delay for a microwave signal reflected from plasma. This method allows to study not only the plasma density profiles when the probe signal frequency scanning, but also density profiles at the constant frequency of a microwave signal. The second method is intended for the plasma turbulence study by the reflected signal phase oscillations. Three types of turbulence have been registered by this technique in T-10 plasma. The first type has a range 50 - 200 kHz and is studied at many tokamak by the scattering laser radiation. The second one has a frequency range 15 - 20 kHz and is studied at many tokamaks by the scattering laser radiation. The second one has a frequency range 15 - 20 kHz and it is probably the tearing mode instability. The third type has a frquency higher than 1 MHz, its physical nature has not been determined yet. 3 refs.; 2 figs.

23802 (INIS-SU—72, pp 50-52) **Nature of the anomalous electron transport across the magnetic field in a trap with the steep density profile.** Ioffe, M.S.; Kanaev, B.I.; Pastukhov, V.P.; Piterskij, V.V.; Yushmanov, E.E. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Thermonuclear synthesis. Scientific-technical collection.

Investigations in Atoll device which is cusped magneto-electrostatic trap (MET) are described. Confinement of the MET are governed by the processes of electron transport across magnetic field. As was found earlier, this transport is much faster than classical diffusion one and so it has anomalous nature. The results of study of the anomalous transport mechanism are presented. 3 refs.; 2 figs.

23803 (INIS-SU—72, pp 52-54) **Formation of stationary states of a plasma with a separatrix.** Dnestrovskij, Yu.N.; Zotov, I.V.; Kostomarov, D.P.; Popov, A.M. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Thermonuclear synthesis. Scientific-technical collection.

A model of forming a toroidal plasma configuration with a separatrix in the presence of passive discrete conductors is described. Intermediate states of proposed scenario are respective to vertical displacement. 3 refs.; 2 figs.

23804 **(INT—191/P) Back decay of muonic molecular resonances and the measured value of dμd - formation rate in muon-catalyzed fusion in deuterium.** Gula, A.; Adamczak, A.; Bubak, M. (Joint Inst. for Nuclear Research, Dubna (USSR)). (Institute of Physics and Nuclear Techniques, Krakow (Poland)). 1985. 13p. NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706202/JAW.

It is shown that the experimental values of dμd formation rate, obtained without taking into account the decay of the μ-molecular resonance compound [(dμd)/sup +/dee]/sup */ back to the formation channel dμ+D/sub 2/, are underestimated.The correction depends on the rate of this resonance back decay and the rates of processes leading to fusion in dμd. For their current estimates the correction significantly exceeds the experimental error of the uncorrected dμd formation rate λ/sub m//sup obs/ = 2.76 +- 0.08 μs/sup -1/ reported recently. It is argued that back decay may lead to variation of λ/sub m//sup obs/ with target density which may provide useful information on the parameters of muon-catalyzed fusion. 18 refs., 2 figs.

23805 **(IPPJ—868) Stability of spheromak against current driven modes. Effects of flux hole on stability.** Kamitani, Atsushi. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Apr 1988. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757236/JAW.

The effects of the flux hole on the magnetohydrodynamic (MHD) stability of the spheromak are investigated. Since finite element codes such as ERATO code and ERATO-J code are not able to analyse the plasma containing the symmetry axis in itself, the numerical code by use of which the linearized MHD equation can be integrated in time has been developed. By use of this code, linear growth rates of the n = 1 mode are evaluated as functions of the flux-hole size and the prolateness parameter L/R, where L and R denote the height and the radius of the drum-type flux conserver, respectively. The results of computations show that the flux hole has the destabilizing effects on the spheromak and that a stable configuration with a small flux hole is obtained when the flux conserver is oblate enough to satisfy L/R < approx 1.8 +- 0.1.

23806 **(IPPJ—893) 10 channel grating polychromator for the measurements of electron cyclotron emission.** Kawahata, Kazuo; Sakai, Kiyomi; Ando, Ritoku; Ohara, Sinji; Fujita, Junji. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1988. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757237/JAW.

A 10-channel grating polychromator has been developed and applied for the measurements of the second harmonic electron cyclotron emission from the JIPP T-IIU tokamak plasma. The frequency resolution measured at 150 GHz is about 3 GHz which corresponds to the spatial resolution of 1.8 cm near the center of the plasma column. The grating efficiency is about 80 % for S-polarization around 160 GHz. Its excellent time resolution, Δt ≦ 2 μs, is favorable for studying MHD activities in hot plasmas. It has been found from the measurements in JIPP T-IIU that the grating polychromator is a powerful diagnostic tool for the measurements of electron temperature of the plasma.

23807 **(IPPJ-DT—141) Physics on high density pinch plasma and its applications.** Miyamoto, Tetsu (ed.) (Nihon Univ., Tokyo (Japan). Atomic Energy Research Inst.). (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1988. 63p. (In Japanese). (CONF-8712137—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88757240/JAW.

From Symposium on physics on high density pinch plasmas and its applications; Nagoya, Japan (14 Dec 1987).

Symposium on 'Physics on high density pinch plasmas and its applications' was held at Institute of Plasma Physics, Nagoya University on 14 and 15 December 1987 under the collaborating research program of the Institute. The symposium was attended by forty-six researchers from eighteen laboratories, and twenty-three papers were presented. The subjects of the presented papers were classified as dynamical behavior of Z-pinch plasmas (6 papers), radiation processes (4), intense X-ray sources for the X-ray lithography (2), pulsed power systems (2), pinch diodes and a pinch plasma channel for ion beams (4), a review article (1) and others (5). No paper was presented in this symposium to deal with excitation of X-ray laser and generation of an extremely high magnetic field by means of a Z-pinch. These subjects were, however, reported in some talks. It was recognized that they were important and interesting subjects for future Z-pinch research.

23808 **(JAERI-M—88-222) Control of the configuration in JT-60 lower X-point divertor plasma.** Yoshino, Ryuji. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Nov 1988. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757259/JAW.

This paper presents experimental results of the configuration-control of lower X-point divertor plasmas in JT-60. Vertical positional instability is well stabilized by the combination control of horizontal magnetic field coil current and divertor coil current, where the latter one flows just below a vacuum vessel and reinforces the control of vertical plasma position. Therefore plasma elongation of {similar←to}1.40 with n/sub index/ of -1.80 has been obtained, Where -1.80 is almost same level with -n/sub S//sup SD/ , that is the passive index obtained from the combination of horizontal magnetic coil and divertor magnetic coil.

23809 **(JAERI-M—88-249) Mapping model for trapped particles in a toroidal ripple field.** Foit, J.J.; Tani, Keiji; Takizuka, Tomonori; Azumi, Masafumi. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). (Japan Atomic Energy Research Inst., Tokyo). Dec 1988. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757275/JAW.

The effect of magnetic field ripple in a tokamak on banana particles can be studied by means of an area-preserving mapping. An approximative formula for the toroidal precession of a banana orbit is derived. For area-preserving and non-conservative mapping based on this formula the border of global stochasticity is determined and the structure of the phase space is investigated in terms of the Liapunov characteristic exponents. Finally, the power loss fraction of alpha particles in a collisional plasma is computed and compared with results obtained by a guiding-center orbit-following code. In a collisional plasma, both results of area-preserving and non-conservative mappings are in good agreement with the results obtained from the guiding-center orbit-following code. In a collisionless plasma, however, a substantial difference is found between the results from area-preserving and non-conservative mappings.

23810 **(LRP—367/88) Optical diagnosis of electrostatic waves in the ion gyrofrequency range via the ion dielectric response.** Good, T.N.; Skiff, F.; Anderegg, F.; Paris, P.J.; Tran, M.Q.; Rynn, N.; Stern, R. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Nov 1988. 14p. (CONF-880735—3). NTIS (US Sales Only), PC A03/MF A01 - OSTI. Order Number DE89008512/JAW.

From International workshop on nonlinear phenomena in Vlasov plasmas; Cargese, France (11 Jul 1988).

We present experiments that utilize Laser Induced Fluorescence (LIF) measurements of a component of the perturbed ion velocity distribution in the fields of externally excited electrostatic waves with frequencies near the ion cyclotron frequency. We show that the distribution function oscillates coherently at the wave frequency, and that a linear analysis of these coherent fluctuations allows a determination of wave characteristics such as the electric field amplitude and wave vector. Three methods are described which directly indicate wave properties via the perturbed ion distribution, f/sup (1)/(v,x,t) and the zero and first order moments of f/sup (1)/(v,x,t) and the zero and first order moments of f/sup (1)/(v,x,t). We demonstrate that this non-perturbative diagnostic is a powerful tool in the study of wave excitation and wave particle interactions. 12 refs., 5 figs.

23811 **(PFC/JA—89-3) Electron cyclotron heating studies of the Compact Ignition Tokamak (CIT).** Porkolab, M.; Bonoli, P.T.; Englade, R.; Myer, R.; Smith, G.R.; Kritz, A.H. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Jan 1989. Contract AC02-78ET51013. 5p. (CONF-890302—18). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008759/JAW.

From 16. European conference on controlled fusion and plasma physics; Venice, Italy (13 Mar 1989).

The Compact Ignition Tokamak (CIT) operating scenario calls for ramping the toroidal magnetic field from B/sub T/ = 7.0 (8.0) to 10.0 Tesla in a few seconds, followed by a burn cycle and a ramp-down cycle. Simultaneously, the plasma must be heated from an initial low beta equilibrium ({bar {beta}} ≃ 0.44% at 7.0 to 8.0 Tesla) to a final burn equilibrium ({bar {beta}} = 2.8%) having 10.0 Tesla on the magnetic axis. Since the toroidal plasma current will be ramped at the same time and since the available time for flat-top magnetic field must be reserved for the burn cycle, it is imperative that densification and heating be carried out as the magnetic field is ramped. Here we examine an approach which is applicable to ECR heating. The frequency remains constant, while the angle of injection is varied by simply rotating a reflecting mirror placed in the path of the incident microwave beam. The rotating mirror permits one to launch waves with sufficiently high N/sub {parallel}/ so that the Doppler broadened resonance of particles on the magnetic axis with f = 280 GHz and B/sub T/ = 7.0–8.0 Tesla can provide adequate absorption. As the resonance layer moves toward the magnetic axis the beam is swept toward perpendicular to reduce the Doppler width and avoid heating the plasma edge. At B/sub T/ = 10.0 Tesla the beam will be at normal incidence with strong absorption immediately on the high field side of the resonance (relativistic regime). We envisage using the ordinary mode (O-mode, {rvec E}/sub RF/ {parallel} {rvec B}) of polarization which is accessible from the outside (low-field side) of the torus provided the density is such that ω/sub pe/ ≦ ω ∼ ω/sub ce/ (max). 8 refs., 3 figs.

23812 **(PPPL—2575) Numerical solutions of magnetohydrodynamic stability of axisymmetric toroidal plasmas using cubic B-spline finite element method.** Cheng, C.Z. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Dec 1988. Contract AC02-76CH03073. 53p. (CONF-890479—2). NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89004635/JAW.

From 7. international conference on finite element methods in flow problems; Huntsville, AL, USA (3 Apr 1989).

A nonvariational ideal MHD stability code (NOVA) has been developed. In a general flux coordinate ({psi}, θ, {zeta}) system with an arbitrary Jacobian, the NOVA code employs Fourier expansions in the generalized poloidal angle θ and generalized toroidal angle {zeta} directions, and cubic-B spline finite elements in the radial {psi} direction. Extensive comparisons with these variational ideal MHD codes show that the NOVA code converges faster and gives more accurate results. An extended version of NOVA is developed to integrate non-Hermitian eigenmode equations due to energetic particles. The set of non-Hermitian integro-differential eigenmode equations is numerically solved by the NOVA-K code. We have studied the problems of the stabilization of ideal MHD internal kink modes by hot particle pressure and the excitation of "fishbone" internal kink modes by resonating with the energetic particle magnetic drift frequency. Comparisons with analytical solutions show that the values of the critical β/sub h/ from the analytical theory can be an order of magnitude different from those computed by the NOVA-K code. 24 refs., 11 figs., 1 tab.

23813 **(PPPL—2601) Sawtooth oscillation in tokamaks.** Park, W.; Monticello, D.A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1989. Contract AC02-76CH03073. 17p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009642/JAW.

A three-dimensional nonlinear toroidal full MHD code, MH3D, has been used to study sawtooth oscillations in tokamaks. The profile evolution during the sawtooth crash phase compares well with experiment, but only if neoclassical resistivity is used in the rise phase. (Classical resistivity has been used in most of the previous theoretical sawtooth studies.) With neoclassical resistivity, the q value at the axis drops from 1 to about 0.8 before the crash phase, and then resets to 1 through a Kadomtsev-type complete reconnection process. This $\Delta q_0 \simeq 0.2$ is much larger than Δq/sub o/ ≃ 0.01, which is obtained if classical resistivity is used. The current profile is strongly peaked at the axis with a flat region around the singular surface, and is similar to the Textor profile. To understand this behavior, approximate formulas for the time behavior of current and q values are derived. A functional dependence of sawtooth period scaling is also derived. A semi-empirical scaling is found which fits the experimental data from various tokamaks. Some evidence is presented which indicates that the fast crash time is due to enhanced effective resistivity inside the singular current sheet, generated by, e.g., microinstability and electron parallel viscosity with stochastic fields at the x-point. 16 refs., 5 figs.

23814 **(PPPL—2602) Visible imaging of edge fluctuations in TFTR.** Zweben, S.J.; Medley, S.S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1989. Contract AC02-76CH03073. 31p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009641/JAW.

Images of the visible light emission from the inner wall region of TFTR have been made using a rapidly gated, intensified TV camera. Strong "filamentation" of the neutral deuterium Dα light is observed when the camera gating time is <100 μsec during neutral-beam-heated discharges. These turbulent filaments vary in position randomly vs. time and have a poloidal wavelength of ∼3-5 cm which is much shorter than their parallel wavelength of ∼100 cm. A second and new type of edge fluctuation phenomenon, which we call a "merfe," is also described. Merfes are a regular poloidal pattern of toroidally symmetric, small-scale marfes which move away from the inner midplane during the current decay after neutral beam injection. Some tentative interpretations of these two phenomena are presented. 27 refs., 8 figs.

23815 **(UCID—21574-DRAFT-Rev.1) Compendium of computer codes for the researcher in magnetic fusion energy.** Porter, G.D. (ed.). (Lawrence Livermore National Lab., CA (USA)). 10 Mar 1989. Contract W-7405-ENG-48. 71p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009010/JAW.

This is a compendium of computer codes, which are available to the fusion researcher. It is intended to be a document that permits a quick evaluation of the tools available to the experimenter who wants to both analyze his data, and compare the results of his analysis with the predictions of available theories. This document will be updated frequently to maintain its usefulness. I would appreciate receiving further information about codes not included here from anyone who has used them. The information required includes a brief description of the code (including any special features), a bibliography of the documentation available for the code and/or the underlying physics, a list of people to contact for help in running the code, instructions on how to access the code, and a description of the output from the code. Wherever possible, the code contacts should include people from each of the fusion facilities so that the novice can talk to someone "down the hall" when he first tries to use a code. I would also appreciate any comments about possible additions and improvements in the index. I encourage any additional criticism of this document. 137 refs.

23816 **(UCLA/PPG—1228) A fast spatial scanning combination emissive and mach probe for edge plasma diagnosis.** Lehmer, R.D.; LaBombard, B.; Conn, R.W. (California Univ., Los Angeles (USA). Inst. for Plasma and Fusion Research). Apr 1989. Contract FG03-86ER52134. 76p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009674/JAW.

A fast spatially scanning emissive and mach probe has been developed for the measurement of plasma profiles in the PISCES facility at UCLA. A pneumatic cylinder is used to drive a multiple tip probe along a 15cm stroke in less than 400msec, giving single shot profiles while limiting power deposition to the probe. A differentially pumped sliding O-ring seal allows the probe to be moved between shots to infer two and three dimensional profiles. The probe system has been used to investigate the plasma potential, density, and parallel mach number profiles of the presheath induced by

a wall surface and scrape-off-layer profile modifications in biased limiter simulation experiments. Details of the hardware, data acquisition electronics, and tests of probe reliability are discussed. 30 refs., 24 figs.

23817 **(UCRL—99981) Computation of lower hybrid, neutral beam and bootstrap currents in consistent MHD equilibria.** Devoto, R.S.; Blackfield, D.T.; Fenstermacher, M.E.; Bonoli, P.T.; Porkolab, M. (Lawrence Livermore National Lab., CA (USA)). 1 Feb 1989. Contract W-7405-ENG-48. 6p. (CONF-890302—19). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008892/JAW.

From 16. European conference on controlled fusion and plasma physics; Venice, Italy (13 Mar 1989).

A possible scenario for steady state current drive in large, high- temperature tokamaks includes current driven by lower hybrid (LH) waves in the outer region with high-energy neutral beams (NB) used for current drive in the core. In addition, provided the poloidal beta is sufficiently high, there can be substantial bootstrap (BS) current, as observed in the TFTR and JET experiments. In work reported previously, a computer code, ACCOME, was written to obtain a solution to the MHD equations which is consistent with current driven by neutral beams, electric fields, and neoclassical (bootstrap) effects. For the computation of the solution to the Grad-Shafranov equation, the SELENE code is used. Iteration is necessary between SELENE and the current-drive computations to obtain a consistent solution. In this paper we describe modifications to ACCOME to enable the computation of LH current in addition to the NB, BS, and OH currents. The next section describes the models used and then the final section presents an application to ITER. 4 refs., 4 figs.

23818 **(UCRL—100499) High energy density fusing using the Compact Torus.** Hartman, C.W. (Lawrence Livermore National Lab., CA (USA)). 15 Feb 1989. Contract W-7405-ENG-48. 9p. (CONF-880967—6). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008120/JAW.

From Fusion Power Associates annual meeting and symposium on the creation of compact, high power density plasmas; Santa Fe, NM, USA (6 Sep 1988).

My remarks are concerned with employing the Compact Torus magnetic field configuration to produce fusion energy. In particular, I would like to consider high energy density regimes where the pressures generated extend well beyond the strength of materials. Under such conditions, where nearby walls are vaporized and pushed aside each shot, the technological constraints are very different from usual magnetic fusion and may admit opportunities for an improved fusion reactor design. 5 refs., 3 figs.

23819 **Spectroscopic diagnostic of an x-ray laser plasma by use of L-shell spectra.** Peyrusse, O.; Combis, P.; Louis-Jacquet, M.; Naccache, D.; Keane, C.J.; McGowan, B.J.; Matthews, D.L. (Commissariat a l'Energie Atomique, Centre d'Etudes de Limeil-Valenton, B. P. 27, 94190 Villeneuve-Saint-Georges, France). *Journal of Applied Physics;* **65**: No. 10, 3802-3805(15 May 1989).

The x-ray spectrum in the range of Ne-like selenium resonance lines coming from a soft x-ray laser plasma has been used to make a spectroscopic diagnostic of the plasma. We performed a modelization of the emission. Computing intensity ratios of Ne-like resonance lines and Na-like satellite lines, plasma parameters (density and temperature) have been obtained. The temperature deduced from the model is found to be lower than expected in hydrodynamical calculations from other authors.

23820 **Nonlinear self-sustainment of magnetic islands.** White, R.B.; Romanelli, F. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physics of Fluids B: Plasma Physics;* **1**: No. 5, 977-979(May 1989).

A mechanism is proposed for a nonlinear self-sustainment of magnetic islands that relies on the presence of a chaotic region. Particles diffusing in the stochastic magnetic field produce a local increase of current at X points on a rational surface, which in turn sustains the original perturbation if the equilibrium profile is concave. It is shown that the new equilibrium is stable. In a tokamak the mechanism is operative in the region outside the $q = 2$ surface, in agreement with the observation of strong electron confinement degradation in this region.

23821 **Stability analysis of magnetohydrodynamic equilibria: Comparing the thermodynamic approach with the energy principle.** Brinkmann, R.P. (Department of Astronomy and Astrophysics, Enrico Fermi Institute, The University of Chicago, Chicago, Illinois 60637). *Physics of Fluids B: Plasma Physics;* **1**: No. 5, 987-995(May 1989).

This paper is a contribution to the stability analysis of current-carrying plasmas, i.e., plasma systems that are forced by external mechanisms to carry a nonrelaxing electrical current. Under restriction to translationally invariant configurations, the thermodynamic stability criterion for a multicomponent plasma [Phys. Rev. Lett. 56, 143 (1986); Phys. Fluids 30, 3713 (1987)] is rederived within the framework of nonideal magnetohydrodynamics (MHD). The chosen dynamics neglects scalar resistivity, but allows for other types of dissipation effects both in Ohm's law and in the equation of motion. In the second section of the paper the thermodynamic stability criterion is compared with the ideal MHD based energy principle of Bernstein et al. [Proc. R. Soc. London Ser. A 244, 17 (1958)]. With the help of Schwarz's inequality it is shown that the former criterion is always more "pessimistic" than the latter, i.e., that thermodynamic stability implies stability according to the MHD principle, but not vice versa. This result confirms the physical plausible idea that dissipational effects tend to weaken the stability properties of current-carrying plasma equilibria by breaking the constraints of ideal MHD and allowing for possibly destabilizing effects such as magnetic field line reconfiguration.

23822 **Thermal diffusivity induced by resistive pressure-gradient-driven turbulence.** Carreras, B.A.; Diamond, P.H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-8071). *Physics of Fluids B: Plasma Physics;* **1**: No. 5, 1011-1017(May 1989).

The calculation of the thermal diffusivity induced by resistive pressure-gradient-driven turbulence is revisited. The relevant correlation length for the magnetic fluctuations is shown to be different from estimates made with a mixing-length approach and with dimensional analysis. This leads to different scaling predictions for the electron heat diffusivity. The root of this difference is the fact that the flux and current perturbations are related by two scale lengths, the poloidal wavelength and the mode width.

23823 **Proton ring formation and trapping in a gated magnetic mirror.** Pedrow, P.D.; Greenly, J.B.; Hammer, D.A.; Sudan, R.N. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14853). *Physics of Fluids B: Plasma Physics;* **1**: No. 5, 1059-1072(May 1989).

A detailed study of the trapping of proton rings in a magnetic mirror both in uniform gas fillings and in localized puffed-gas fillings is presented. The trapping of about 3×10^{14}, 400 keV protons in a 1.5 m long, 0.8 T magnetic mirror was accomplished with a static 1.23:1 downstream mirror and a fast "gate" upstream mirror with mirror ratio $<1.3{:}1$. Protons were trapped for 4 μs (>50 cyclotron periods) or longer. The proton ring mean radius, length, and annular thickness in the trap were 10 cm, 1.5 m, and 5–8 cm, respectively. Detailed study of the dynamics of the injected and trapped protons with a variety of diagnostic techniques showed that the bulk of the protons followed trajectories that could be fully explained using the ion diode voltage and the details of the applied magnetic field configuration. However, a small fraction of the injected protons had axial energy much higher than was possible from single-particle trajectories; incomplete electrostatic neutralization of the proton ring by the beam-generated plasma in the injection region is postulated to explain this observation. Ring proton lifetime in the mirror trap appeared to be determined by mirror losses upon initially encountering the downstream and then the upstream mirrors, followed by a gradual radial loss due to charge-exchange collisions with the neutral gas contained in the experiment chamber.

23824 **Energy and nonlinearity considerations for the enhanced plasma wave model of Raman scattering.** Simon, A.; Short, R.W. (Laboratory for Laser Energetics, University of Rochester, 250 East River Road, Rochester, New York 14623-1299). *Physics of Fluids B: Plasma Physics;* **1**: No. 5, 1073-1081(May 1989).

Raman scattering in nonuniform laser-produced plasma has been explained [Phys. Fluids 29, 1704 (1986)] as ordinary Raman scattering of the laser light from enhanced plasma waves in the corona. Here, a nonlinear model of the saturated plasma waves and of the fast electron pulses, which create the enhancement, is developed. The saturation level is normalized by use of absolute intensity measurements on the Nova laser [Phys. Rev. Lett. 60, 1018 (1988)], and the fast electron pulse parameters are chosen in agreement with the observed enhanced frequency band. The power in the fast electrons will then be consistent with both that in the laser source and in the drain to the saturated waves. There is agreement with all features of this Nova experiment, including some preliminary measurements of the angular variation of the scattered Raman intensity.

23825 **Scaling of absolutely unstable, stimulated Raman scattering from planar, laser-produced plasmas.** Drake, R.P. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physics of Fluids B: Plasma Physics;* **1**: No. 5, 1082-1088(May 1989).

A study of the scaling of the fraction, f/sub SRS/, of the laser energy scattered by stimulated Raman scattering (SRS) is reported. A simple model of SRS as an absolute instability is presented, leading to the hypothesis that f/sub SRS/ will be determined by the depth of the plasma producing SRS. The results of a number of experiments are used to test this hypothesis. The experiments analyzed used irradiating wavelengths of 1.06, 0.53, and 0.35 μm. In all cases, the plasmas were planar and the electron–ion collision rate was small compared to the homogeneous SRS growth rate. The depth of the plasma, as opposed to the laser intensity or laser wavelength, is found to be the primary determinant of f/sub SRS/. In addition, as the depth of the plasma increases, the angular distribution of the scattering is observed to broaden. The implications of these results for analysis of SRS as an absolute instability and for laser fusion are discussed.

23826 **Hydrodynamic expansion of exploding-foil targets irradiated by 0.53 μm laser light.** Drake, R.P.; Phillion, D.W.; Estabrook, K.; Turner, R.E.; Kauffman, R.L.; Campbell, E.M. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physics of Fluids B: Plasma Physics;* **1**: No. 5, 1089-1096(May 1989).

An experiment is reported in which several diagnostics were used to study the hydrodynamic expansion of exploding-foil targets. The CH targets, 1–3 μm thick, were irradiated with 3–4 kJ of 0.53 μm laser light in 1 nsec pulses. The electron density was diagnosed using the transmission and scattering of light at the laser frequency, the scattering of light at 3/2 of the laser frequency, the spectrum of Raman-scattered light, the x-ray spectrum from doped targets, and the image of the ultraviolet bremsstrahlung emission from the plasma. The measurements were consistent with one another, but generally were not consistent with two-dimensional computer simulations. The targets burned through later and took longer after burnthrough to reach quarter-critical density than predicted. This discrepancy may be a consequence of excessive profile steepening caused by the local, heat-transport model used in the simulation.

23827 **Reduction of emission in the stimulated Raman scattering frequency band to thermal noise levels by collisional damping in a laser-produced plasma.** Drake, R.P.; Williams, E.A.; Young, P.E.; Estabrook, K.; Kruer, W.L.; Baldis, H.A.; Johnston, T.W. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **39**: No. 7, 3536-3540(1 Apr 1989).

We report measurements of the noise level of light emissions in the frequency band of the stimulated Raman scattering (SRS) instability. Long-scale-length planar plasmas were produced from thin gold targets using 0.35-μm laser light. At laser intensities up to 5 x 10/sup 14/ W/cm^2, the SRS was completely quenched by collisional damping, and the emissions were thermal, as evidenced by their time dependence and by their spectrum. The onset of SRS was consistent with theory, and the SRS spectral power was five orders of magnitude larger than thermal at a laser intensity of 4 x 10/sup 15/ W/cm^2.

23828 **Production and maintenance of high poloidal beta tokamak plasmas by means of rf current drive.** Luckhardt, S.C.; Chen, K.; Coda, S.; Kesner, J.; Kirkwood, R.; Lane, B.; Porkolab, M.; Squire, J. (Plasma Fusion Center and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* **62**: No. 13, 1508-1511(27 Mar 1989).

It is shown that in tokamak plasmas sustained by rf current drive, the contribution of the suprathermal rf-driven electron population to the poloidal beta (β/sub p/) can be substantial if the total current is comparable to the Alfven critical current, I/sub A/ = $(4\pi mcv/\mu_0 ec)\gamma$. Equilibria with values of $\epsilon\beta$/sub p/ up to approximately 1.3 were obtained, and no equilibrium or gross stability limits were observed.

23829 **Nonlinear behavior of the reversed field pinch with nonideal boundary conditions.** Ho, Y.L.; Prager, S.C.; Schnack, D.D. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review Letters;* **62**: No. 13, 1504-1507(27 Mar 1989).

The effect of a resistive boundary and/or a distant conducting wall on a reversed field pinch is investigated with a three-dimensional magnetohydrodynamics code. Fluctuations rise with increasing distance between the conducting wall and the plasma. The enhanced fluctuation-induced v x b electric field primarily opposes toroidal current; hence loop voltage must increase to sustain the current. This increases the helicity injection rate, which is balanced by an enhanced surface loss.

23830 **Convergence properties of a nonvariational 3D MHD equilibrium code.** Greenside, H.S.; Reiman, A.H.; Salas, A. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544-0451). *Journal of Computational Physics;* **81**: No. 1, 102-136(Mar 1989).

Details are presented of the PIES code, which uses a nonvariational algorithm for calculating fully three-dimensional MHD equilibria. The convergence properties of the code are studied for several axisymmetric and nonaxisymmetric finite β equilibria that have magnetic surfaces. copyright 1989 Academic Press, Inc.

23831 **Performance and optimization of direct implicit particle simulation.** Cohen, B.I.; Langdon, A.B.; Hewett, D.W.; Procassini, R.J. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Computational Physics;* **81**: No. 1, 151-168(Mar 1989).

Performance characteristics obtained from particle simulations using the direct implicit method are presented. Parameter studies of simulation behavior for an expanding plasma slab have been made determining code performance as functions of ω/sub p//sub e/Δt and Δx/λ/sub D//sub e/, where ω/sub p//sub e/ is the plasma frequency, λ/sub D//sub e/ is the electron Debye length, Δt is the time step, and Δx is the grid spacing. A range of time steps ω/sub p//sub e/Δt≦200 and mesh sizes Δx/λ/sub D//sub e/≦100 were explored. Accurate results for low-frequency phenomena resolved by the time step can be obtained without limit on ω/sub p//sub e/Δt in this range (and higher) with a careful choice of algorithms. This choice of algorithms defeats a potential nonlinear instability that occurs when $(\omega/\text{sub p//sub e/}\Delta t)^2$ exceeds the number of particles per cell. copyright 1989 Academic Press, Inc.

23832 **Particle simulation of bounded 1D plasma systems.** Lawson, W.S. (Electronics Research Lab, University of California, Berkeley, California). *Journal of Computational Physics;* **80**: No. 2, 253-276(Feb 1989).

The physical and numerical problems of kinetic simulation of a bounded electrostatic plasma system in one planar dimension are examined, and solutions to them are presented. These problems include particle absorption, reflection and emission at boundaries, the

solution of Poisson's equation under non-periodic boundary conditions, and the treatment of an external circuit connecting the boundaries. The methods which are described here are implemented in a code named PDW1, which is available from Professor C. K. Birdsall, Plasma Theory and Simulation Group, Cory Hall, University of California, Berkeley, CA 94720. copyright 1989 Academic Press, Inc.

23833 Helical ripple transport in stellarators at low-collision frequency. Beidler, C.D. Madison, WI; Univ. of Wisconsin (1987). 310p. University Microfilms Order No. 88-00,346.

Thesis (Ph. D.).

Numerical and analytical techniques were developed to investigate the plasma transport due to particles trapping/detrapping in the local helical ripple wells of a stellarator's magnetic field. This process is of considerable importance as it provides the dominant transport mechanism in a stellarator plasma at low collision frequency; that is, when the frequency with which a particle is collisionally detrapped from a local ripple well is less than the bounce frequency of the particle in that well. A form of the longitudinal adiabatic invariant, J, is constructed and shown to describe accurately the orbits of ripple-trapped particles. Unlike previous expressions for J, the form derived here correctly accounts for the local toroidal variation in the magnetic field. The expression for J is incorporated into a rapid hybrid Monte Carlo simulation of ripple transport in stellarators. The simulation is a hybrid in the sense that particle orbits in the narrow region of phase space on either side of the ripple trapping/detrapping boundary are followed using guiding center equations of motion while orbits in the remainder of phase space are described using adiabatic invariants.

23834 Oscillating field-current drive in the reversed-field pinch. Scardovelli, R.A.U. Urbana-Champaign, IL; Univ. of Illinois (1987). 183p. University Microfilms Order No. 88-03,192.

Thesis (Ph. D.).

Oscillating Field-Current Drive (OFCD) was originally proposed as a means of maintaining a quasi-steady-state plasma current in a RFP without building up the magnetizing flux threading the central hole of the torus. The MHD dynamics of OFCD is analyzed using a combination of a 1-D transport code, a linear resistive MHD stability model, and Kadomtsev nonlinear global reconnection model. Using Faraday's law, Ohm's law and on-axis regularity conditions, it is shown that $m = 1$ modes are necessary for current drive, within the resistive MHD model. A class of $m = 1$ tearing modes that nonlinearly generate poloidal flux (a necessary condition for current drive) was identified. These modes are destabilized by off-axis current peaks. A scoping study of the F-Theta space was undertaken to determine quantitatively the effectiveness of this class of tearing modes as a current-drive mechanism. A scenario of the OFCD oscillations was developed in terms of the evolution of the safety-factor profile, by considering the stability of the RFP to current-driven tearing modes. Transport simulations of the single-circuit oscillations indicate that the RFP dynamo is definitely present during half of the oscillation period, while the other half cycle exhibits only small off-axis current peaks at best.

23835 Ion phase-space transport. Sheehan, D.P. Irvine, CA; Univ. of California (1987). 498p. University Microfilms Order No. 88-03,868.

Thesis (Ph. D.).

Experimental measurements are presented of ion phase-space evolution in a collisionless magnetoplasma utilizing nonperturbing laser-induced fluorescence (LIF) diagnostics. Ion-configuration space and velocity-space transport, and ion thermodynamic information were derived from phase-space diagrams. The ions were roughly mass-symmetric. Plasma systems were reconstructed from multiple discrete Ba(II) ion-velocity distributions with spatial, temporal, and velocity resolution of 1 mm^3, 2 μsec, and 3×10^{10} cm^3/sec^3 respectively. Phase-space reconstructions indicated resonant ion response to the current-driven electrostatic ion cyclotron wave (EICW) in the case of an electron beam and to the ion cyclotron-cyclotron wave in the case of ion beams. Ion energization was observed in both systems. Local-particle kinetic-energy densities increase far above thermal levels in the presence of the EICW and ICCW. Time-resolved measurements of the EICW identified phase-space particle bunching.

7002 Fusion Power Plant Technology

REFER ALSO TO CITATION(S) 23784, 23825

23836 (CONF-890278—1) The development of low-activation alloys at ORNL. Klueh, R.L. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 32p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007834/JAW.

From IEA low-activation workshop; Los Angeles, CA, USA (21 Feb 1989).

The objective of this program is to advance the technology of reduced-activation ferritic steels, austenitic stainless steels, and vanadium alloys to the point where these alloys could be considered as the structural material for fusion reactors in preference to the conventional high-activation alloys; and develop alloys to meet US Nuclear Regulatory Commission 10CFR61 guidelines for shallow land burial. 20 figs., 1 tab.

23837 (CONF-890482—1) Graphite to Inconel brazing using active filler metal. King, J.F.; Baity, F.W.; Walls, J.C.; Hoffman, D.J. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number TI89004185/JAW.

From 20. AWS international brazing and soldering conference; Washington, DC, USA (4 Apr 1989).

Ion cyclotron resonant frequency (ICRF) antennas are designed to supply large amounts of auxiliary heating power to fusion-grade plasmas in the Toroidal Fusion Test Reactor (TFTR) and Tore Supra fusion energy experiments. A single Faraday shield structure protects a pair of resonant double loops which are designed to launch up to 2 MW of power per loop. The shield consists of two tiers of actively cooled Inconel alloy tubes with the front tier being covered with semicircular graphite tiles. Successful operation of the antenna requires the making of high integrity bonds between the Inconel tubes and graphite tiles by brazing. This paper discusses this process.

23838 (CONF-8810231—9) Electromagnetic railgun hydrogen pellet injector: Progress and prospect. Kim, Kyekyoon. (Illinois Univ., Urbana (USA). Fusion Technology Lab.). Dec 1988. Contract FG02-84ER52111. 10p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009536/JAW.

From IAEA technical committee meeting on pellet injection and toroidal confinement; Gut Ising, F.R. Germany (24 Oct 1988).

A two-stage, fuseless, plasma-arc-driven electromagnetic railgun system suitable for hydrogen pellet acceleration has been developed and successfully tested. The first stage is a combination of a hydrogen pellet generator and a gas gun, which is responsible for injecting a medium-velocity hydrogen pellet into the second-stage railgun through a coupling piece. As the pellet enters the railgun, a specially designed arc-initiation scheme electrically breaks down the propellant gas which has followed the pellet from the gas gun into the railgun, thus forming a conducting plasma-arc armature immediately behind the pellet. This arc formation event coincides with the triggering of the main railgun current and allows the plasma-arc armature to subsequently propel the hydrogen pellet to a high velocity. Using this two-stage acceleration scheme with a 1-m-long railgun barrel, solid hydrogen pellet velocities in excess of 2.2 km/s have been achieved for a pellet 3.2 mm in diameter and 4 mm in length. The objectives of this paper are two-fold: first, a critical review of the achievements thus far on the railgun hydrogen-pellet injector and second, a description of the most recent technological developments and their implications for future work, in particular, the prospect of employing a railgun pellet injector for future large devices. 6 refs., 2 figs., 1 tab.

23839 (DOE/DP/40200—87) Improved laser-beam uniformity using the angular dispersion of frequency-modulated light. Skupsky, S.; Short, R.W.; Kessler, T.; Craxton, R.S.; Letzring, S.; Soures, J.M. (Rochester Univ., NY (USA). Lab. for Laser Energetics). Mar 1989. Contract FC03-85DP40200. 31p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009135/JAW.

A new technique is presented for obtaining highly smooth focused laser beams. This approach is consistent with the constraints on frequency tripling the light, and it will not produce any significant high-intensity spikes within the laser chain, making the technique attractive for the high-power glass lasers used in current fusion experiments. Smoothing is obtained by imposing a frequency-modulated bandwidth on the laser beam using an electro-optic crystal. A pair of gratings is used to disperse the frequencies across the beam, without distorting the temporal pulse shape. The beam is broken up into beamlets, using a phase plate, such that the beamlet diffraction-limited focal spot is the size of the target. The time-averaged interference between beamlets is greatly reduced because of the frequency differences between the beamlets, and the result is a relatively smooth diffraction-limited intensity pattern on target. 12 refs., 8 figs.

23840 **(DOE/ER/52077—1) Heat transfer and conductor stability in pool boiling helium: Final report, March 1, 1985--February 29, 1988.** Van Sciver, S.W. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering and Engineering Physics). 14 Mar 1989. Contract AC02-82ER52077. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009144/JAW.

For the designated three year period, the Applied Superconductivity Center of the University of Wisconsin-Madison has undergone a series of experimental investigations of heat transfer and stability of composite superconductors. This work has attempted to answer critical physical questions related to use of superconducting magnets in fusion engineering systems. The program has been focused in three primary areas: measurement of heat transfer to pool boiling liquid helium; development of temperature sensors for transient temperature measurement; and measurement of stability in a composite conductor cooled internally with He II. Also during this period, we reported on the performance of a high field (B = 13 T) superconducting magnet system for use in stability experiments. 7 refs.

23841 **(DOE/ER/52127—39) D-^{3}He fuel cycles for neutron lean reactors.** Kernbichler, W.; Miley, G.H.; Heindler, M. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1988. Contract FG02-86ER52127. 7p. (CONF-881031—67). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008764/JAW.

From 8. topical meeting on technology of fusion energy; Salt Lake City, UT, USA (9 Oct 1988).

The intrinsic potential of D-^{3}He as a reactor fuel is investigated for a large range of 3He to D density ratios. We employ a steady-state zero-dimensional reactor model in which much care is attributed to a proper treatment of fast fusion products. Useful ranges of reactor parameters as well as temperature-density windows for driven and ignited operation are identified. Various figures of merit are calculated, such as power densities, net power production, neutron production, tritium load and radiative power. These results allow us to draw several optimistic conclusions about the performance of D-^{3}He as a reactor fuel. 11 refs., 5 figs.

23842 **(DOE/ER/52127—41) Advanced fuels for heavy ion beam fusion.** Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1988. Contract FG02-86ER52127. 26p. (CONF-8806101—11). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008887/JAW.

From International symposium on heavy ion inertial fusion; Darmstadt, F.R. Germany (28 Jun 1988).

The potential of using advanced fuel heavy-ion beam fusion is discussed as an avenue for achieving improved environmental and safety in a fusion power plant. Deuterium targets ignited by a D-T spark region (AFLINT concept) are viewed as the most practical near-term approach. An earlier reactor study (LOTRIT) using this concept is reviewed to evaluate the potential improvement in safety/environment impact. The result, including a reduction of tritium inventory by two orders of magnitude, suggests that this route to heavy-ion beam fusion should receive serious consideration. 19 refs., 3 figs., 4 tabs.

23843 **(DOE/ER/52127—49) Critical issues from SAFFIRE.** Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1988. Contract FG02-86ER52127. 33p. (CONF-8810331—1-Vugraphs). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008688/JAW.

From US/Japan workshop on D-He/sup 3/FRCs; Chicago, IL, USA (5 Oct 1988).

SAFFIRE signifies a Self-Sustained, Advanced-Fuel Field-REversed Configuration. It was devised in an earlier conceptual design study a D-He3 pilot unit to demonstrate on a near term scale the feasibility of burning advanced fuels / EPRI AP-1437, July 1980/. Topics covered in the design report include: equilibrium field and diamagnetic current contributions; fueling; plasma stability; SAFFIRE start-up; fusion product heating and transport; divertor design; blanket energy recovery systems; pilot unit; small size power reactor; cost estimate and economic plausibility of SAFFIRE; comparison of direct capital costs; SAFFIRE indirect costs and cell cost reduction. Critical issues from this work will be discussed with emphasis on problems related to steady-state operation. These include fueling and diamagnetic currents, ash build-up, and the gas blanket. Comments will also be given about the mass production concept and cost projections for a reactor version of SAFFIRE.

23844 **(DOE/ER/52133—3) ICRF waveguide launcher research: Final progress report, June 1986--February 1989.** Scharer, J.E. (Wisconsin Univ., Madison (USA). Dept. of Electrical and Computer Engineering). 28 Feb 1989. Contract FG02-86ER52133. 19p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009151/JAW.

The research we have accomplished during the past year includes the topics of ICRF fast wave coupling to L- and H-mode edge profiles, measurements of simulated plasma loads on a dielectric-filled 85 MHz waveguide launcher and an analysis of coupling of ion Bernstein waves. We have also carried out a computer simulation, fabrication and initial laboratory measurements on a 2 GHz scale model vacuum folded guide launcher. We have also begun to examine coupling between launched fast waves and ion Bernstein waves driven by density gradients near the plasma edge and the effects of known edge turbulence and ponderomotive forces on the direct launching of ion Bernstein waves. 7 refs., 8 figs., 1 tab.

23845 **(DOE/ER/52148—1) Radiation damage to fusion reactor materials: Progress report, November 18, 1987 to July 15, 1988.** Kulcinski, G.L.; Dodd, R.A.; Griffin, R.; Han, S.; Plantz, D.; Seitzman, L.; Wang, L. (Wisconsin Univ., Madison (USA)). 1988. Contract FG02-88ER52148. 45p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008606/JAW.

The activities in the past year have been focussed on four areas: radiation damage resistance of low activation ferritic steels; effect of residual oxygen on the radiation damage resistance of 316 SS; the response of Ni and Ni based alloys to high temperature radiation; the resistance of Cu alloys to high temperature irradiation. A brief summary of these projects is given in this paper.

23846 **(GA-A—19547) The DIII-D collaborative advanced divertor program.** Mahdavi, M. Ali; Schaffer, M.; Mioduszewski, P.; Bauer, W.; Gauster, W.; Porter, G.D.; Hill, D.H.; Conn, R. (General Atomics, San Diego, CA (USA)). Feb 1989. Contract AC03-89ER51114. 28p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008758/JAW.

This document outlines a collaborative plan to study and enhance the performance of DIII-D diverted plasmas by controlling edge plasma and neutral particles. The predicted density control will provide DIII-D the capability of carrying out more systematic experiments (decoupling tokamak density and current) and enable DIII-D to operate in lower density, higher temperature regimes useful for optimizing and studying transport and current drive. The program also includes significant experiments on plasma surface interactions, material testing, non-inductive current drive by divertor biasing, and edge plasma stabilization. These experiments are of great interest for next generation tokamaks such as ITER and CIT.

23847 **(IAE—4543/8) Induction load supplying from inductive storage using current doubling circuit.** Mazulin, A.V.; Pankov, I.I.; Ryabtsev, G.V.; Ryazanov, K.P.; Shcherbitskij, V.N.; Yagnov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706152/JAW.

Problem of energy transfer from inductive energy storage, composed of 2/sup n/ sections, to induction load is considered. It is shown that efficiency of energy transfer in the system with the load, shunted by nonlinear resistor, can achieve 0.7 at 30% energy spread in nonlinear resistor. Transfer efficiency grows up to 1.0 under induction load, shunted by interstage capacitor for inductive energy storage, composed of 32 sections; doesn't exceed 3% of storage capacity. Possibility of application of the given systems for supplying tokamak coils is shown. 3 refs.; 15 figs.

23848 (INIS-SU—72, pp 3-8) **On the kinetics of nuclear reactions in thermonuclear plasma.** Putvinskij, S.V. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Thermonuclear synthesis. Scientific-technical collection.

The paper is dedicated to the study of thermonuclear reactions kinetics within the frameworks, necessary for plasma diagnostics. Experimental data on cross sections of corresponding nuclear reactions are collected in the paper as well. Approximation formulae, describing dependences of cross sections on reacting particle energies, are selected for these data. Dependences of $<\sigma V>$ reaction rates on Maxwell plasma temperature and approximation formulae for some reactions as well are presented. Formulae for calculating the energy spectra of thermonuclear reaction products, and for some particular cases - calculation results of spectra of neutrons, γ-particles, protons etc are presented. Calculations for source power and energy spectra of secondary reaction products are carried out. Energy gains are calculated at the test ion movement in thermonuclear plasma for the reactions which are of particular interest for energy production. 18 refs.; 4 figs.; 2 tabs.

23849 (INIS-SU—72, pp 12-16) **Parametric study of a thermonuclear power plant based on a gas-dynamic trap.** Krivosheev, M.V.; Katyshev, V.V. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Thermonuclear synthesis. Scientific-technical collection.

Parametric study is carried out to evaluate the main characteristics of hybrid thermonuclear power plant (TNPP), based on gas-dynamic trap and its separate systems. Study is conducted by means of simplified mathematical model, which connects plasma parameters with the facility main systems: magnetic system, blanket, plasma heating systems and energy transformation. Specific costs of electric energy, released by complex, consisting of hybrid TNPP and nuclear power plants, which consum secondary nuclear fuel, produced in the blanket, were used as the criterion while searching the facility optimal characteristics. The facility possible parameters are presented. Study shows, that costs of the realized electric energy may be comparable with those for replaceable power plants at thermal power levels, which are by several times higher, than power of the to-day NPP, and at rather high (3 - 5 MW/m/sup 2/) neutrom loads onto the vacuum chamber wall. 13 refs.; 4 figs.; 1 tab.

23850 (INIS-SU—72, pp 8-11) **Helium pumping-out in the INTOR-OTR-type tokamak.** Krasheninnikov, S.I. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Thermonuclear synthesis. Scientific-technical collection.

The possibility of helium pumping-out from the INTOR-OTR type tokamak is considered. Simple criterion of impurity entrainment by the main plasma flux is obtained. Influence of transverse diffusion on the impurity behaviour is analyzed. Estimation of neutral helium flux from the divertor plates to the pumping-out is obtained. Estimations of helium ion flux to the divertor plates in the INTOR-OTR type reactor at the permissible levels of α-particle containment in the main plasma show, that it is by approximately one order higher, than the necessary value of helium flux, pumped-out from the reactor. It gives principle opportunity to carry out the required regimes of helium pumping-out in INTOR-OTR divertor. 6 refs.; 1 fig.

23851 (INIS-SU—72, pp 17-21) **Analysis of the Uragan-2M torsatron magnetic configuration.** Bykov, V.E.; Georgievskij, A.V.; Kuznetsov, Yu.K.; Nemov, V.V.; Peletminskaya, V.G.; Khodyachikh, A.V. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Thermonuclear synthesis. Scientific-technical collection.

Magnetic congigurations of the Uran-2M device (an l=2 torsatron with an additional toroidal field) have been analyzed under different operating conditions. Studies have been made to find out the effects of different factors such as the helical winding law, the pole shape, the ratio of the helical-winding toroidal field to the total toroidal field B/sub 0/, and also the transverse magnetic field to B/sub 0/ ratio, on the magnetic surface parameters, viz., dimensions of the outer unbroken surface, the angles of rotational transform on this surface and on the axis on the magnetic well depth. 5 refs.; 4 figs.

23852 (INIS-SU—72, pp 21-24) **Numerical simulation of the longitudinal magnetic field of a tokamak with account for eddy currents.** Lamzin, E.A. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Thermonuclear synthesis. Scientific-technical collection.

Peculiarities of the numerical simulation algorithm for oxisymmetric quasistationary electromagnetic fields are presented with account of ferromagnet saturation effects and dependence of current-carrying elements on temperature. Studies on the evaluation of corrugation of the pulse toroidal magnetic field for the Tuman-3 facility are carried out. 10 refs.; 4 figs.

23853 (INIS-SU—72, pp 43-45) **Ultimate slope torsatrons.** Vorob'eva, V.P.; Georgievskij, A.V.; Lyubarskij, G.Ya. and others. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Thermonuclear synthesis. Scientific-technical collection.

Magnetic configuration and geometry of the ultimate slope (l=2, 3 and 4) torsatrons with A/sub B/ aspect ratio of the helical windings (HW) near (A/sub B/ {similar←to}1.0 - 1.5) unit are investigated. HWs with number of periods by the large torus perimeter m/sub B/=1 are considered. Due to the magnetic system ultimate large toroidality it was necessary to consider many variants to choose the acceptable solutions regarding the production technology simplicity and the efficient arrangement of boundary magnetic surface. This part of investigation was conducted by the machined designed methods with plotting of helical lines on the torus and winding different cross sections by means of a plotter. 4 refs.; 2 figs.; 1 tab.

23854 (INIS-SU—72, pp 48-50) **Modeling the magnetic configuration of the Drakon device.** Kurnaev, V.A.; Lazarev, S.L.; Perelygin, S.F.; Smirnov, V.M. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.

In Thermonuclear synthesis. Scientific-technical collection.

Computer calculations are carried out and experimental facility, which consists of forty round section single coils and simulates two periods for 5-period helical torus, is built to control magnetic configuration properties of the Drakon stationary plasma trap curvilinear element. Results of the theoretical study on diffusion and heat conductivity demonstrate the dramatic decrease of corpuscular and thermal fluxes and of plasma losses in the Drakon trap as compared to the closed system without straight elements. 4 refs.; 1 fig.

23855 (INIS-SU—72, pp 36-40) **Sediments on the limiter of the L-2 stellarator.** Popov, S.N.; Reiner, H.; Hildebrandt, D. 1988. (In Russian). NTIS (US Sales Only), PC A04/MF A01; INIS. Order Number DE89780074/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.
In Thermonuclear synthesis. Scientific-technical collection.

Structure and composition of sediments on the limiter of the L-2 stellator are investigated. Energy fluxes, which constitute >50% of Joule energy, contributed to the plasma, are measured calorimetrically on the limiter. Asymmetry of energy fluxes and doped sediments, that is, energy flux prevalence from the limiter ion side and vice versa, iron and oxygen sediments predominance from the electron side, is shown. It is determined, that sediments observed asymmetry does not correspond to the asymmetry, recorded on the tokamaks. Many tracks of microarcs, drifting almost perpendicularly to the magnetic field direction, are observed on the electron side, while on the ion one - only separate tracks. Mean number of the metal precipitated atoms on the limiter is 10/sup 15/ per one pulse, that constitutes {similar←to}0.03% of ion total number in the L-2 plasma. 6 refs.; 7 figs.

23856 (INIS-SU—75, pp 67-71) **Geodesic adjustment of telescopes of laser power installations.** Gostev, A.M.; Drobikov, A.V.; Shtorm, V.V. 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01; INIS. Order Number DE89780081/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 2.
In Construction and building. Scientific-technical collection.

Analysis of the accuracy of geodesic adjustment of lenses in telescopic pairs of laser power installation under different sequence of lens setting is presented with calculation example and experimental testing of results. 3 refs.; 2 tabs.

23857 **(IPP—2/294) Analytical solution of the magnetic field, current density, force density and mechanical stresses for a toroidal shell.** Harmeyer, E. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). May 1988. 36p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757373/JAW.

For a toroidal shell of finite wall thickness subjected to a given current distribution the related magnetic field distribution is obtained. This allows one to derive the stored magnetic energy of the system, and the distributions of the force density and the mechanical stresses in the shell. Furthermore, the mechanical stresses in the shell are determined for the force density distributions f/sub rho/=const. and f/sub rho/ proportional to 1/r. The virial theorem is applied to the configurations considered and is compared to results of the analytical solutions developed in this study. These analytical solutions supplement the numerical calculations for the modular stellarator coil systems treated in IPP report 2/298.

23858 **(IPP—2/298) Investigation of nonplanar modular coil systems for stellarator fusion reactors.** Harmeyer, E. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Technische Hochschule Darmstadt (Germany, F.R.)). Dec 1988. 112p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88757374/JAW.

Steady-state stellarators constitute an important option for a future fusion reactor. The helical magnetic field required for plasma confinement can be produced by means of a set of modular nonplanar coils. In order to achieve optimum power density of the plasma, the magnetic flux density inside the torus is made as high as possible. State-of-the-art estimates allow values of the magnetic flux density on axis of B/sub 0/ = 4-7 T. The present report is concerned with investigations on modular nonplanar stellarator coil systems. Coil systems with poloidal periodicity l=2 and a coil system of the W VII-AS type with superposed l=0, 1, 2, 3 terms are treated. Furthermore, the parameters are simultaneously varied while keeping constant the ratios of certain magnitudes. In the parameter space of the geometric values and coil number the following quantities are evaluated: maximum magnetic flux density in the coil domain, stored magnetic energy of the coil system, magnetic force density distribution or magnetic forces, and mechanical stress distribution in the coils. Numerical methods are applied in the programme systems used for these calculations. The aim of the study is to determine an optimum regime for the above parameters. The numerical results are compared with those of analytical approximation solutions.

23859 **(IPPJ—894) Impurity pellet injection into current-driven plasmas of the JIPPT-IIU tokamak.** Morita, S.; Kawatoh, E.; Ohkubo, K. and others. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1988. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757238/JAW.

Impurity pellets of stainless steel and plastic carbon with a size of 0.5 mmphi and a velocity of 400 +- 100 m/s have been injected into fast-wave-current-driven plasmas with a sustained plasma current of 35 - 50 kA and an electron density of 2 - 4 x 10/sup 12/ cm/sup -3/ to study the interaction between them. The current-driven plasmas show no disruption at the pellet injection, whereas all of the ohmic discharges are disruptive. These phenomena are interpreted briefly with results of a sudden decrease of the electron temperature and density rises of 6 - 8 x 10/sup 12/ cm/sup -3/ for the iron pellet and 4 x 10/sup 12/ cm/sup -3/ for the carbon pellet. The electron temperature after the injection is estimated to be about 10 eV from the density rise and the calculation of the impurity charge states. The decaying time of the injected impurity is measured to be 25 ms from the time behaviour of the soft x-ray emission.

23860 **(IPPJ-DT—140) Proceedings of the symposium on technology in laboratories.** (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1988. 239p. (In Japanese). (CONF-8803201—). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88757239/JAW.

From Symposium on technology in laboratories; Nagoya, Japan (29 Mar 1988).

The Symposium on Technology in Laboratories was held on March 29 and 30, 1988 at Toyota Auditorium in Nagoya University. This symposium was hosted by Institute of Plasma Physics. Participants were about 210 and 54 papers were presented from many of Japanese universities and laboratories. Technical experience and new technics were reported and discussed divided into five sessions; technologies of manufacture, cryogenic, diagonostic and control system, computer and experimental apparatus.

23861 **(JAERI-M—88-204) TSTA loop operation with 100 grams-level of tritium. Milestone run in June, 1987.** Yoshida, Hiroshi; Hirata, Shingo; Naito, Taisei and others. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Oct 1988. 108p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88757248/JAW.

The first loop operation tests of Tritium Systems Test Assembly (TSTA) with 100 grams-level of tritium were carried out at Los Alamos National Laboratory(LANL) on June and July, 1987. The tests were one of the milestones for TSTA goal scheduled in June, 1987 through June, 1988. The objectives were (i) to operate TSTA process loop composed of tritium supply system, fuel gas purification system, hydrogen isotope separation system, etc, (ii) to demonstrate TSTA safety subsystems such as secondary containment system, tritium waste treatment system and tritium monitoring system, and (iii) to accumulate handling experience of a large amount of tritium. This report describes the plan and procedures of the milestone run done in June and the summary results especially on the safety aspects. Analysis of the emergency shutdown of the process loop, which happened in the June run, is also reported. A brief description of the process and safety subsystems as well as the summary of the TSTA safety analysis report is included.

23862 **(JAERI-M—88-234) Computational form for DT fusion output power from toroidal plasma.** Takizuka, Tomonori; Yamagiwa, Mitsuru. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Nov 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757267/JAW.

The simple computational form for the DT fusion output power from a toroidal plasma is presented, which is very useful in

course of the zero-dimensional analysis on a fusion reactor plasma. The profiles of densities of deuteron and triton are assumed to be proportional to (1 - rhc/sup 2/)/sup α-/n, and ion temperature profile is assumed to be proportional to (1 - rho/sup 2/)/sup α-/T. The power is given as a function of plasma volume, V/sub P/, averaged densities of deuteron and triton, <n/sub D/> and <n/sub T/>, averaged ion temperature, <T/sub i/>, and profile parameters, α/sub n/ and α/sub T/. The output power is maximized at the optimum averaged temperature under the condition of constant pressure. The "maximum fusion output power coefficient", F, is introduced. The maximum power under the condition of constant pressure is given by P/sub f/ = F x 4 V/sub P/<n/sub D/><n/sub T/><<T/sub i/>>/sup 2/, where <<T/sub i/>> denotes the density weighted averaged ion temperature. The coefficient, F, is approximated as a linear function of α/sub T/ and α/sub n/, F = 0.01 x (0.7 + 0.355 α/sub T/ + 0.405 α/sub n/) MW center dot 10/sup -40/ m/sup 3/ center dot keV/sup -2/.

23863 (JAERI-M—88-242) TSTA loop operation with 100 grams-level of tritium. Full components milestone run in June, 1988. Yoshida, Hiroshi; Fukui, Hiroshi; Hirata, Shingo and others. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Dec 1988. 77p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757272/JAW.

A fully integrated loop operation test of Tritium systems Test Assembly (TSTA) with 107 grams of tritium was completed at Los Alamos National Laboratory (LANL) in June, 1988. In this test, a compound cryopump with a charcoal panel was incorporated into the main process loop for the first time. The objectives were (i) to demonstrate the compound cryopump system with different flow rates and impurities, (ii) to demonstrate the regeneration of the compound cryopump system, (iii) to accumulate operating experience with other process systems such as the fuel cleanup system, the isotope separation system, the tritium supply and recovery system, etc. and (iv) to improve the data-base on TSTA safety systems such as the secondary containment system, tritium waste treatment system and tritium monitoring system. This report briefly describes characteristics of the main subsystems observed during the milestone run.

23864 (KAERI/RR—545/86) Development of tritium removal technology. Kim, Yong Eak; Sung, Ki Woung; Na, Jung Won; Chung, Hong Suck; Kim, Kwang Rag; Ahn, Do Hee; Cho, Young Hyun; Paek, Seung Woo. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Dec 1986. 240p. (In Korean). NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS. Order Number DE88705851/JAW.

Liquid Phase Catalytic Exchange (LPCE)- Cryogenic Distillation(CD) process was studied which could be available for an optimal tritium removal process of pressurized heavy water reactor system at Wolsung nuclear power plant in the near future. Based upon analysis of reaction mechanism of hydrogen isotope exchange, process simulation by computer with process variables for tritium separation were carried out. And a fundamental research about hydrogen isotope exchange catalyst and a basic study on ortho-para hydrogen conversion catalyst were carried out. Also, system simulation for heat recovery of distillation process was studied for energy cost safety. Mainly, hydrophobic Pt-C catalyst system as a core material of LPCE was investigated, and an absorber model of heat pump was set-up.

23865 (LA-UR—88-3748) Advanced KrF laser designs for ICF [inertial confinement fusion]. Harris, D.B. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-890423—8). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89003478/JAW.

From CLEO '89: conference on lasers and electro optics; Baltimore, MD, USA (24 Apr 1989).

KrF lasers are an attractive driver for both near-term and long-term applications of inertial fusion. The design of the KrF laser driven Laboratory Microfusion Facility and intermediate steps will be presented. 2 refs. 1 fig.

23866 (LA-UR—89-366) Progress toward the delivery of high energy pulses with the Aurora KrF/ICF laser system. Rosocha, L.A.; Anderson, R.G.; Czuchlewski, S.J.; Hanlon, J.A.; Jones, R.G.; Kang, M.; Mansfield, C.R.; Thomas, S.J.; Watt, R.G.; Figueira, J.F. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-881244—9). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007750/JAW.

From LASERS '88; Lake Tahoe, NV, USA (5 Dec 1988).

Because of the attractiveness of short wavelength lasers for inertial confinement fusion (ICF), the Los Alamos National Laboratory is engaged in a program to investigate the feasibility of high power KrF lasers as future ICF drivers. The main hardware element in this program is the Aurora KrF laser system, which is a prototype for demonstrating the applicability of optical angular multiplexing and serial amplification by large electron-beam-driven KrF laser amplifiers to potential large-scale fusion drivers. Multiplexing is a straightforward scheme for matching the energetic component ({approximately}5 ns) of the required target pulse to the longer pulse time ({approximately}500 ns) required for practical, efficient large-scale KrF laser amplifier operation. Aurora uses a multiplexed 96-element train of 5-ns pulses, which is amplified and passed through a demultiplexer, where all pulses in the train are stacked in time by using suitable time-of-flight delays. Presently, the laser system is configured to deliver 48 stacked 5-ns pulses to the target at multikilojoule energy levels. In principal, it is possible to extract energy levels exceeding 10 kJ from the final Aurora amplifier. In this paper, we will report on the performance of the front end, amplifiers, and the optical train. Amplifier improvements, energy extraction experiments, and subsequent progress in the delivery of demultiplexed pulses to the target plane will also be discussed. As of this conference, we have tested the amplifier upgrade hardware, measured the gain on two modified amplifiers, installed optics on the main power amplifier, sized the beams to the target chamber, and begun firing the amplifier chain in a step-by-step process of integration from the front end lasers to the target plane. At the time of presentation, the second amplifier in the chain of four has exceeded the original design output of 50 J by more than 20%. 11 refs., 15 figs., 3 tabs.

23867 (LA-UR—89-911) High-performance deuterium-lithium neutron source for fusion materials and technology testing. Lawrence, G.P.; Bhatia, T.S.; Blind, B.; Guy, F.W.; Krakowski, R.A.; Neuschaefer, G.H.; Schnurr, N.M.; Schriber, S.O.; Varsamis, G.L.; Wangler, T.P. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 5p. (CONF-890335—22). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009287/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

Advances in high-current linear-accelerator technology since the design of the Fusion Materials Irradiation Test (FMIT) Facility have increased the attractiveness of a deuterium-lithium (D-Li) neutron source for fusion materials and technology testing. This paper discusses a new approach to such a source aimed at meeting the near-term requirements of a high-flux high-energy International Fusion Materials Irradiation Facility (IFMIF). The concept employs multiple accelerator modules providing deuteron beams to two liquid-lithium jet targets oriented at right angles. This beam/target geometry provides much larger test volumes than can be attained with a single beam and target and produces significant regions of low neutron-flux gradient. A preliminary beam-dynamics design has been obtained for a 250-mA reference accelerator module. Neutron-flux levels and irradiation volumes were calculated for a neutron source incorporating two such modules, and interaction of the beam with the lithium jet was studied using a thermal-hydraulic computer simulation. Cost estimates are provided for a range of beam currents and a possible facility staging sequence is suggested. 12 refs., 7 figs., 3 tabs.

23868 **(SAND—88-2705C) A conceptual design for an LMF [Laboratory Microfusion Facility] accelerator module.** Johnson, D.L.; Ramirez, J.J.; Stinnett, R.W.; Coachman, K.B. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 16p. (CONF-890335—7). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008825/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

The US Department of Energy has initiated a design study of a Laboratory Microfusion Facility (LMF) that will be used to develop high-gain ICF targets. A conceptual design for a light ion beam accelerator has been developed for a multimodule LMF system based on technology demonstrated on Sandia's Hermes-III accelerator. The LMF accelerator module incorporates 32 linear induction cavities, each operating at 1 MV, to produce an output voltage pulse that ramps from 27 to 32 MV with a peak current of 1.2 MA. The power for the accelerator module is derived from sixteen Marx generators that drive 128, 4-Ω, 54-ns pulse forming lines (PFL). Four PFL pulses are combined in each inductive cavity. Nanosecond synchronization of the PFL output pulses is accomplished using KrF laser triggered output gas switches and low jitter, self-breakdown water switches. The outputs of the cavities are added in a magnetically insulated transmission line (MITL) and then delivered to an extraction ion diode. Singly-ionized lithium ions are accelerated in the diode. Voltage ramping is used to achieve power compression of the ion beam when ballistically drifted to the ICF target. An equivalent circuit has been developed to model the module from the Marx generator to the ion diode. The timing performance of the gas and water switches has been included in the model to calculate the resulting output waveform and system jitter. 10 refs., 9 figs., 1 tab.

23869 **(SAND—88-2770C) Very high pulse-energy accelerators.** Ramirez, J.J. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 23p. (CONF-890335—42). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008824/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

The dominant trend in the development of pulsed power accelerator technology over the last decade has been towards higher power and shorter pulse widths. Limitations in high voltage, high current switch performance, and in power flow through vacuum insulator housings led to the development of highly modular designs. This modular approach requires precise synchronization of the various modules and efficient methods of combining the power from these modules to drive a common load. The need to drive very low impedance loads led to effective ways to combine these modules in parallel. The PBFA I and Saturn are representative of these designs. The PBFA-II Li^+ ion diode requires a higher voltage than provided by previous systems. The modules of this accelerator are arranged in stacked layers. Modules feeding each layer are added in parallel at a vacuum insulator housing and the outputs from several layers are then added in series by a self-magnetically insulated vacuum transmission line (MITL) to generate a 10 MV to 15 MV output pulse. Hermes III represents a new approach towards the efficient generation of higher voltages. It is designed to drive a 22-MV, 730-kA, 40-ns electron beam diode and combines conventional, modular pulsed power technology with linear induction accelerator concepts. High-power induction accelerator cavities are combined with voltage addition along a MITL to generate the desired output. This design differs from a conventional linac in that the voltages are added by the MITL flow rather than by a drifting beam that gains kinetic energy at each stage. This design is a major extrapolation of previous state-of-the-art technology represented by the injector module of the Advanced Test Accelerator and has proven to be efficient and reliable. The design and performance of Hermes III are presented together with a discussion of the application of this technology to the light ion beam inertial confinement fusion program. 18 refs., 12 figs.

23870 **(SAND—89-0736C) Status of the PBFA-II light ion beam fusion program.** Quintenz, J.P.; Bailey, J.E.; Bieg, K.W.; Bloomquist, D.D.; Cook, D.L.; Crow, J.T.; Coats, R.S.; Derzon, M.S.; Desjarlais, M.P.; Dreike, P.L. (Sandia National Labs., Albuquerque, NM (USA)). [1989]. Contract AC04-76DP00789. 5p. (CONF-890335—13). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009070/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

PBFA II is the first pulsed power accelerator designed and built specifically to produce light ions for driving targets in Sandia National Laboratories inertial confinement fusion program. Recent progress in ion beam generation and focusing has been excellent. Record ion beam intensities have been obtained. Development of an extensive array of diagnostics and advances in the theory of ion diodes have had a major impact on this progress. A summary of recent progress and the present status of the PBFA-II light ion beam fusion program is given. 40 refs., 4 figs.

23871 **(UCID—21642) Analysis of quench-vent pressures for present design of ITER TF coils.** Slack, D.S. (Lawrence Livermore National Lab., CA (USA)). 20 Mar 1989. Contract W-7405-ENG-48. 13p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009711/JAW.

An analysis of pressure and temperature rise versus time during a quench is done here for one of the present TF coil designs. Hand calculations using worksheets give a fair approximation of such parameters as pressure and temperature in the conductor, stored energy consumed by the quench, amount of vented helium, etc. The purpose is to provide design information for conductor design before a more accurate computer analysis is completed and to serve as a check against other analyses. An additional purpose is to provide insights into the quench vent process that may aid the designer of protective devices. 3 figs., 3 tabs.

23872 **(UCLA/PPG—1218) Reduced particle recycling from topographically modified graphite surfaces: Non-saturable walls in toroidal devices.** Hirooka, Y.; Conn, R.W. (California Univ., Los Angeles (USA). Inst. for Plasma and Fusion Research). Aug 1988. Contract AS03-84ER52104. 20p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008949/JAW.

This paper briefly describes the following topics: an overview of graphite wall pumping effects; wall pumping experiments in PISCES-A; and non-saturable walls in toroidal devices. 11 figs., 2 tabs. (LSP)

23873 **(UCRL—94601) Preparation and properties of polymer foams for ICF targets.** Letts, S.A.; Lucht, L.M. (Lawrence Livermore National Lab., CA (USA)). Sep 1986. Contract W-7405-ENG-48. 27p. (CONF-861019—28). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009957/JAW.

From 10. international vacuum congress and 6. international conference on solid surfaces and the 33. national symposium of the American Vacuum Society; Baltimore, MD, USA (27 Oct 1986).

Low density small cell sized foams were developed to localize the liquid DT layer in a direct drive wetted foam laser fusion target. We have developed foams made from ultrahigh molecular weight polyethylene gels and polystyrene inverse emulsions. Materials in the density range of from 0.020 to 0.300 g/cc were prepared and characterized for cell size, mechanical properties, machinability, specific surface area, and wetting. Foams with a density of 0.05 g/cc were made with a cell size of less than 5 μm. A cell structure model was developed which relates the density and specific surface area to cell size and cell wall thickness. Wetting tests in organic solvents and in liquid hydrogen were used to characterize the capillary pressure, pore structure and uniformity of the foams. 13 refs., 9 figs., 2 tabs.

23874 **(UCRL—97713) High efficiency second-to-fourth harmonic conversion in KDP.** Chaffee, P.H.; Ehrlich, R.B. (Lawrence Livermore National Lab., CA (USA)). 20 Nov 1987. Contract W-7405-ENG-48. 8p. (CONF-880402—11). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009260/JAW.

From CLEO '88: OSA/IEEE conference on lasers and electro-optics; Anaheim, CA, USA (25 Apr 1988).

Second-to-fourth harmonic conversion efficiencies of 80% in a Nd:YLF oscillator/glass amplifier system have been achieved. At high fourth harmonic intensities, beam break up and anomalous pulse shape effects are observed. 2 refs., 2 figs.

23875 **(UCRL—99425) High index of refraction films for dielectric mirrors prepared by metal-organic chemical vapor deposition.** Brusasco, R.M. (Lawrence Livermore National Lab., CA (USA)). Jan 1989. Contract W-7405-ENG-48. 12p. (CONF-890145—21). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008037/JAW.

From SPIE conference on optics, electro-optics and laser applications in science and engineering: OE/LASE '89; Los Angeles, CA, USA (15 Jan 1989).

A wide variety of metal oxides with high index of refraction can be prepared by Metal-Organic Chemical Vapor Deposition. We present some recent optical and laser damage results on oxide films prepared by MOCVD which could be used in a multilayer structure for highly reflecting (HR) dielectric mirror applications. The method of preparation affects both optical properties and laser damage threshold. 10 refs., 8 figs., 4 tabs.

23876 **(UCRL—99631) Octopole correction of geometric aberrations for high-current heavy-ion fusion beams.** Ho, D.D.M.; Haber, I.; Crandall, K.R.; Brandon, S.T. (Lawrence Livermore National Lab., CA (USA)). 17 Mar 1989. Contract W-7405-ENG-48. 5p. (CONF-890335—54). NTIS, PC A02 - OSTI. Order Number DE89009906/JAW.

From 13. particle accelerator conference; Chicago, IL, USA (20 Mar 1989).

The success of heavy-ion fusion depends critically on the ability to focus heavy-ion beams to millimeter-size spots. Third-order geometric aberrations caused by fringe fields of the final focusing quadrupoles can significantly distort the focal spot size calculated by first-order theory. We present a method to calculate the locations and strengths of the octopoles that are needed to correct these aberrations. Calculation indicates that the strengths of the octopoles are substantially less than that of the final focusing quadrupoles. 9 refs., 1 fig.

23877 **(UCRL—99741) Accumulated surface damage on ZnS crystals produced by closely spaced pairs of picosecond laser pulses.** Chase, L.L.; Lee, H.W.H. (Lawrence Livermore National Lab., CA (USA)). Dec 1988. Contract W-7405-ENG-48. 17p. (CONF-8810284—2). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008813/JAW.

From Laser induced damage in optical materials; Boulder, CO, USA (26 Oct 1988).

Excitation of a transparent ZnS crystal by repetitive picosecond dye laser pulses causes an accumulated surface modification leading to optical damage. The onset of the damage is detected by an abrupt increase in the emission of neutral Zn (and possibly S_2) from the surface. Comparison of the neutral emission thresholds with pulse-pair and single-pulse excitation shows that linear absorption is the dominant laser-surface interaction. In general, this measurement technique shows considerable promise for investigating the possible influence of nonlinear absorption or excitation processes on damage mechanisms. The data suggest that heating of small absorbing regions produces the surface modification that leads to the observed surface ablation. The nature of the damage observed at fluences above the threshold suggests that it is caused by heating of a relatively large ({approximately}10 - 100 μm) surface region that has been modified by the accumulation pulses. 3 refs., 5 figs.

23878 **(UCRL—99948) Frequency modulation for suppression of stimulated Brillouin scattering in large optics.** Wilcox, R.B. (Lawrence Livermore National Lab., CA (USA)). 10 Nov 1988. Contract W-7405-ENG-48. 10p. (CONF-890423—23). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number TI89003268/JAW.

From CLEO '89: conference on lasers and electro optics; Baltimore, MD, USA (24 Apr 1989).

We describe an electro-optic frequency modulator used with a 1.05 micron Nd:YLF laser in the master oscillator of Nova. A high voltage photoconductive switch produces a 1.4 kv 2.2 GHz RF burst which drives a lithium niobate phase modulator. The optical bandwidth is 17GHz. 2 refs., 3 figs.

23879 **(UCRL—99951) Pulse shaping on the Nova laser system.** Lawson, J.K.; Speck, D.R.; Bibeau, C.; Weiland, T.L. (Lawrence Livermore National Lab., CA (USA)). 6 Feb 1989. Contract W-7405-ENG-48. 10p. (CONF-890423—7). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008026/JAW.

From CLEO '89: conference on lasers and electro optics; Baltimore, MD, USA (24 Apr 1989).

Inertial confinement fusion requires temporally shaped pulses to achieve high gain efficiency. Recently, we demonstrated the ability to produce complex temporal pulse shapes at high power at 0.35 microns on the Nova laser system. 2 refs., 2 figs.

23880 **(UCRL—99952) Improvements in power, precision, and shot rate from the Nova target irradiation facility.** Speck, D.R.; Bibeau, C.; Ehrlich, R.B.; Henesian, M.A.; Hermes, G.L.; Kyrazis, D.T.; Laumann, C.W.; Lawson, J.K.; Smith, J.R.; Wegner, P.J. (Lawrence Livermore National Lab., CA (USA)). 11 Nov 1988. Contract W-7405-ENG-48. 10p. (CONF-890423—6). OSTI; 1; GPO Dep. Order Number DE89008028/JAW.

From CLEO '89: conference on lasers and electro optics; Baltimore, MD, USA (24 Apr 1989).

Recent improvements in the Nova amplifier system allow us to deliver higher energy and power to targets and to perform experiments with higher precision. Improved operating efficiency has increased the shot rate. 4 refs., 2 figs.

23881 **(UCRL—99999) Temporally smooth broadband pulses obtained by cross phase modulation in an optical fiber.** Chaffee, P.H.; Patterson, F.G.; Henesian, M.A. (Lawrence Livermore National Lab., CA (USA)). 25 Jan 1989. Contract W-7405-ENG-48. 11p. (CONF-890423—8). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008891/JAW.

From CLEO '89: conference on lasers and electro optics; Baltimore, MD, USA (24 Apr 1989).

We have broadened the output spectrum of a single-mode, Q-switched Nd: YLF oscillator ($\lambda = 1.053\mu m$) by co-propagating it with a noisy, broadband pulse in a polarization-preserving fiber. The intensity as a function of time remains smooth, despite the 10^4 increase in bandwidth. 4 refs., 3 figs.

23882 **(UCRL—100478) ICF in the U.S.: Facilities and diagnostics.** Coleman, L.W. (Lawrence Livermore National Lab., CA (USA)). Aug 1988. Contract W-7405-ENG-48. 30p. (CONF-880928—5). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008812/JAW.

From Course and workshop on inertial confinement fusion; Varenna, Italy (6 Sep 1988).

In the last few years there has been significant progress in ICF research in laboratories in the United States and elsewhere. These advances have occurred in areas that range from demonstrating an innovative laser beam smoothing techniques important for both directly and indirectly driven ICF, to achieving a more complete understanding of capsule implosions and related physics. This progress has been possible because of the capabilities provided by the ICF laser-target facilities currently in operation and the new developments in diagnostics, particularly for measurements of the implosion process and the conditions in the compressed capsule core. Both of these topics, facilities and selected new diagnostics

capabilities in the US ICF Program, are summarized in this paper. 32 refs., 19 figs., 6 tabs.

23883 **Plasma opening switch studies of an applied B/sub z/ ion diode.** Struckman, C.K.; Kusse, B.R.; Meyerhofer, D.D.; Rondeau, G. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14853). *Journal of Applied Physics;* **65**: No. 10, 3806-3815(15 May 1989).

The light ion accelerator (1.5 MV, 4 Ω) at Cornell University is being used to study the characteristics of an applied B/sub z/ , or "barrel," diode. We report here the results of a series of experiments utilizing a plasma opening switch. With a magnetically insulated ion diode load, the peak diode voltage increased from 1.5 to 1.8 MV and the ion power increased from 50 to 80 GW when a plasma opening switch was used. Our results are compared with existing theories of plasma opening switch operation.

23884 **Beam profile studies for a phase-mixed ion beam focused with a one-eighth betatron wavelength focusing cell.** Watrous, J.; Ottinger, P.F. (Plasma Physics Division, Plasma Technology Branch, Naval Research Laboratory, Washington, DC 20375). *Physics of Fluids B: Plasma Physics;* **1**: No. 5, 1109-1122(May 1989).

The focusing properties of a one-eighth betatron wavelength focusing cell are used to determine to what extent a modification of the initial phase-space distribution of an ion beam can alter the number density profile of the beam at the focal plane. It is shown that the main modification is to alter the natural 1/r profile to include an off-axis peak. The relative difficulty with which the ion beam can be concentrated into this off-axis peak is then considered. Estimates of the source brightness (extraction ion diode source current density divided by the square of the microdivergence) required to deliver a given amount of beam current into a given annular region at the focal plane are derived.

99 GENERAL AND MISCELLANEOUS

23885 **(CONF-890381—1) Issues in the international economics of industrial mobilization and surge for crisis in an interdependent world.** Sullivan, P. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 61p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008627/JAW.

From 15. annual convention of the Eastern Economic Association; Baltimore, MD, USA (3 Mar 1989).

The purpose of this paper is to present aspects of international trade which are important for industrial mobilization in time of crisis, such as war, famine and natural disasters, in an interdependent world. We will first present an overview of the international trade of the United States in terms of overall imports and exports, imports and exports by major geographical regions, and trade balance of industries important to defense. We will then look at specific characteristics of the international arms trade including some major vulnerabilities and dependencies facing the US. We will then analyze the relative importance of the USSR, the USA, the countries of Western Europe and the third world in the international arms trade. We will then introduce and explain some of the most important concepts of international trade and mobilization including: comparative advantage, absolute advantage,dynamic comparative advantage, strategic comparative advantage and dynamic strategic comparative advantage. While these concepts are being introduced examples of how they can be applied to explain the state of international trade and mobilization will be given. We will briefly describe military and mobilization strategies including the graduated mobilization response framework,conventional strategies, nuclear strategies and the interaction of conventional and nuclear strategies--and how these affect strategic value. All of this will then be put together to describe and analyze international trade as it affects mobilization and the valuation of internationally traded military goods and services directed toward the mobilization. The growing economic, military and diplomatic interdependences of nations will be stressed. 43 refs., 18 tabs.

23886 **(LA-UR—89-442) Knowledge engineering for the instructional developer.** Trainor, M.S. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 11p. (CONF-890371—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007759/JAW.

From National Society for Performance and Instruction (NSPI) conference; Denver, CO, USA (27 Mar 1989).

This paper explores the cognitive approach to instruction and provides several strategies for using knowledge engineering information in the instructional development process to strengthen the systems approach to training. When students learn using the behavioral approach to instruction, drawbacks have been noted because gaps are apparent between the students' high performance levels on objective tests and their inadequate problem solving performance levels. Augmentation of the behaviorist process with applications of knowledge engineering can result in obtaining detailed information about student misconceptions relative to expert knowledge. This information is then applied to individualized learning prescriptions. Normally, instructional developers are working under significant resource and time constraints, and this modified systems approach is an efficient solution to this problem. 13 refs., 1 fig., 1 tab.

23887 **(NP—9770324) Association of Large Research Establishments (AGF). Programme budget 1988.** (Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany, F.R.)). 1988. 86p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89770324/JAW.

This programme budget of the Association of Large Research Establishments (AGF) describes the research and development objectives and the status of the projects in the participating large research establishments and gives details in the medium-term of the yearly expenditure of finance and personnel. The programme budget should make it possible for Parliament and public to form a soundly-based opinion on the role of large research establishments, assign the research and development projects of the large research establishments to the individual sponsoring areas of the Federal Government and so make possible relevant planning of general research objectives and total financing, facilitate and document effective coordination and mutual agreement between the large research establishments in their job planning. In addition the AGF-programme budget 1988 was planned by a study group of the AGF on the basis of the programme budget 1988 of the member societies.

9901 Management

REFER ALSO TO CITATION(S) 21736, 22077, 22100, 22215, 23919

23888 **(CONF-890470—2) Feasibility of quantitative performance measures for evaluating nuclear power plant operators.** Carter, R.J.; Connelly, E.M.; Krois, P.A. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 19p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007846/JAW.

From 8. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (23 Apr 1989).

A more valid measure of team performance in nuclear power plants is needed. A study is described which was oriented towards evaluating the feasibility of synthesizing performance measures by deriving measures for crews responding to an off-normal event in a full-scope simulator. The thesis was that performance assessment is based on the subjective judgment of training instructors. The procedure used to synthesize the performance measure consisted of: identification of the factors believed to be important to performance assessment, development of example crew performances and ratings on each by instructors, and derivation of the measure by capturing the instructors' assessment rules. A performance measure was derived which explains nearly all of the variance of the instructors' team performance assessments. There is reason to believe that this method of synthesizing measures can be applied to other events. 7 tabs.

23889 (DOE/CE/10509—T1) [Technical support services for conservation and renewable energy]: Final report. Thomas, R.J. (Meridian Corp., Alexandria, VA (USA)). 1 Mar 1989. Contract AC01-85CE10509. 94p. NTIS, PC A05 - OSTI. Order Number DE89009119/JAW.

As of November 30, 1988, managerial, technical, analytical and administrative support for the Conservation and Renewable Energy Office of Management and Review (OMR) and the Office of State and Local Assistance Programs (OSLAP), under Contract No. DE-AC01-85CE-10509 was completed. The overall work effort, initiated in September 1985, and performed under 60 individually defined, negotiated and approved Task Orders, was characterized by Meridian's maintenance and application of a flexible and experienced workforce capable of high quality responsiveness to OMR's organizational management needs and OSLAP's technical and programmatic management needs. Support provided to OMR concentrated on CE organizational management concerns. OMR support tasks focused on coordinating and consolidating operating methods and procedures and assisting individual staff members in specific management analysis studies. Support to OSLAP included activities for the Office of the Director as well as each of the Program Offices. Emphasis for OSLAP tasks was on providing technical and analytical support for improving the efficiency and effectiveness of program implementation and management at the headquarters, Support Office, and grantee levels.

23890 (DOE/MA/19116—T1) Managing organizational change seminar. (Training Group, Canal Winchester, OH (USA)). 15 Jun 1988. Contract AC01-86MA19116. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009079/JAW.

This is the final report on the work that The Training Group, Inc. performed for the US Department of Energy against contract Number DE-RP01-86-MA-19116. This fulfills the final reporting requirements of the contract. Since the department intends to recompete this contract for the seminar Managing Organizational Change, we'd like to suggest some ways of using the evaluations from the classes that we have taught to make future Managing Organizational Change seminars even better.

23891 (INIS-BR—1440, pp 62) **Cooperation with IPEN/CNEN-SP.** Antunes, L.J.; Silva, A.G. da; Suita, J.C.; Auler, L.T. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary form only.

23892 (NP—9770296) Annual report of Bayerisches Oberbergamt 1986. (Bayerisches Oberbergamt, Muenchen (Germany, F.R.)). 1987. 141p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89770296/JAW.

By the end of 1986, 5 mines, 26 drift mines, and 188 opencast mines were supervised by the Bavarian Mines Inspectorate, plus a number of boreholes, underground storage facilities, and caverns. The 'classic' tasks are supplemented by new tasks, e.g. supervision of high-pressure gas pipelines, aerial ropeways for public transportation, and support of energy conservation and rational energy use. The report gives a survey of overall trends in mining and of accident statistics. (MOS).

23893 (UCRL—53898) Behavioral styles of engineers in a research and development organization. Donald, L.M. (Lawrence Livermore National Lab., CA (USA)). Aug 1988. Contract W-7405-ENG-48. 86p. NTIS, PC A05/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008649/JAW.

The purpose of the thesis was twofold. First, it determined if there was a behavioral preference of engineers in a technical expert, project leader and line supervisor/manager role. Second, it tested whether there was a correlation between the behavioral preference, job assignment and job satisfaction. 17 refs., 13 tabs.

23894 (WHC-SA—0529) Indoctrination: Using interactive video to teach attitudes and knowledge in general employee training. Smigelski, L.B. (Westinghouse Hanford Co., Richland, WA (USA)). Mar 1989. Contract AC06-87RL10930. 7p. (CONF-890470—4). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008706/JAW.

From 8. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (23 Apr 1989).

The Westinghouse Hanford Company has developed a prototype Interactive Video course, Hanford General Employee Training. Interactive video combines sound, motion, and still photography from a videodisc with the graphics, text, and instructional capability of computer-based instruction. The course includes indoctrination on over 40 topics identified by the Institute of Nuclear Power Operations, the United States Department of Energy, and the Westinghouse Hanford Company that are to be included in the indoctrination of new and requalifying employees. In addition, the course requires trainees to make positive choices when confronted with real life scenarios showing violations of safety, security, and quality standards. This courseware is different from most general employee training courses because it puts the trainee in a role-playing mode and requires the trainee to recognize and respond "in the Westinghouse Hanford way." Initial data project a reduction of 40–60% in training time for Hanford General Employee Training as compared to stand-up instruction.

23895 (ZfI-Mitt—139) 1987 scientific report of the Central Institute for Isotope and Radiation Research. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Jul 1988. 280p. (In English, German). NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS. Order Number DE88706276/JAW.

The publications, lectures, and poster presentations of the Zentralinstitut fuer Isotopen- und Strahlenforschung in the year 1987 are presented as abstracts. Author and subject indexes are included.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 22982

23896 (CNEN-DR-GTT-NT—02/88) Implantation of TRAC-PF1 computer code of VAX-11/750. Madeira, A.A.; Souza Gouvea, L. de; Galetti, M.R.S. (Comissao Nacional de Energia Nuclear, Rio de Janeiro, RJ. Dept. de Reatores). 1988. 63p. (In Portuguese). (CNEN-DR-GAC-NT—07/88). NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS. Order Number DE88705618/JAW.

The implantation of TRAC-PF1 code, IBM version, in VAX-11/750 is described. This work provides Reator Department with an advanced best-estimate tool to perform loss-of-coolant accident analysis.

23897 (CONF-890372—3) Reduction of a general matrix to tridiagonal form using a hypercube multiprocessor. Geist, G.A. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008721/JAW.

From 4. hypercube, concurrent computers and applications; Monterey, CA, USA (6 Mar 1989).

Recently there has been a renewed interest in finding reliable methods of reducing general matrices to tridiagonal form. We have developed a serial reduction algorithm that appears to be very reliable in practice. In this paper we describe a parallel version of our algorithm, which has been implemented using a portable library developed at Oak Ridge National Laboratory (ORNL). The library allows the code to be portable across most commercial hypercubes. The algorithm was developed as one step in the process of finding eigenvalues of nonsymmetric matrices. Our original parallel eigenvalue routines reduced the matrix to Hessenberg form and then applied QR iteration, but their performance was disappointing. Our new parallel routines reduce the matrix to tridiagonal form and then apply LR iteration. Using an iPSC/2, we compare the performance of the new parallel routines with our previous parallel routines and show that the new routines are nearly an order of

magnitude faster, allowing us to solve much larger problems than previously attempted. 14 refs., 6 figs., 2 tabs.

23898 **(CONF-890372—4) A machine-independent communication library.** Geist, G.A.; Heath, M.T.; Peyton, B.W.; Worley, P.H. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008723/JAW.

From 4. hypercube, concurrent computers and applications; Monterey, CA, USA (6 Mar 1989).

In this report we describe a library of routines that enables the development of portable parallel programs. The library is designed primarily to provide portable communication primitives and related system calls for distributed-memory architectures. The package need not be limited to such machines, however, and we expect that the message-passing paradigm on which the library is based will also be useful on other parallel architectures for which data locality is an important performance consideration. The library also provides portable routines to perform certain widely-used, high-level communication operations, such as global broadcast and global sum. Their inclusion frees users from having to develop these commonly needed capabilities or to modify them to run on different machines. Finally, the library provides an execution tracing facility that can be used to monitor performance or to aid in debugging. 1 ref.

23899 **(CONF-890408—2) 3-D discrete ordinates calculations with parallel-vector processors.** Rhoades, W.A.; Flanery, R.E. (Oak Ridge National Lab., TN (USA)). 1989. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE88016795/JAW.

From Advances in nuclear engineering computation and radiation shielding; Santa Fe, NM, USA (9 Apr 1989).

Although three-dimensional (3-D) discrete ordinates calculations are of practical value now, they require that large blocks of computer memory be dedicated for the entire run duration. Depending on system parameters, charges for this memory may comprise most of the cost of solving a problem. One way of alleviating this problem is to assign several processors to work in parallel on the job, thus reducing the time during which the memory must be reserved. When system resources are shared with many other users, the wait time required to obtain results may be several days, and the use of several processors can also reduce that wait. In this study, we apply a small number, i.e., 2 or 4, Cray vector processors sharing a large central memory. A typical discrete ordinates calculation at Oak Ridge uses almost all of its CPU time in three major sections: the discrete ordinates flux sweep, a diffusion-like acceleration sweep, and improvement of the source to eliminate negatives. The present work concentrates on the TORT 3-D code, and on the concrete building problems for which it was designed. 3 refs.

23900 **(CRIE-Y—88003) Framework for evaluating expert system development tools.** Terano, Takao. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Aug 1988. 36p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88756833/JAW.

This paper proposes a practical framework for evaluating and selecting the expert system development tools so that development engineers in public utilities are able to select appropriate tools for their own problems. The framework consists of the following three components. (1) Utilization objectives of the tools were divided into three groups the types of the subjects, the levels of the tool uses and the levels of the users; then, the items necessary for evaluating the tool were clarified. And five types of the checklists for tool evaluation were prepared. (2) In order to avoid specified tool dependency, the concepts of the artificial intelligence were pigeonholed and the general archtecture of the tool function was defined, consequently various tools are able to compared under the same concept. (3) In order to implement easy evaluations on the plural tools from the information in the check lists, a procedure for evaluating the tools by using the Analytic Hierarchy Process was developed. (6 figs, 20 refs)

23901 **(DOE/ER/25026—26) Differential algebraic equations, indices, and integral algebraic equations.** Gear, C.W. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Apr 1989. Contract FG02-87ER25026. 15p. (UIUCDCS-R—89-1505; UILU-ENG—88-1724). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009584/JAW.

In a recent report, Hairer defines the index of Differential Algebraic Equations (DAEs) by considering the effect of perturbations of the equations on the solutions. This index is called the perturbation index, pi. An earlier form of index used by a number of authors is determined by the number of differentiations of the DAEs that are required to generate an ordinary differential equation (ODE) satisfied by the solution. We will call this the differential index, di. Hairer gives an example whose differential index is one and perturbation index is two and other examples where they are identical. We will show that $di \leqq pi \leqq di + 1$ and that $di = pi$ if the derivative components of the DAE are total differentials. This means that the differential components have a first integral. The integrals are a special case of a new type of integral equation we will call Integral Algebraic Equations (IAEs). 3 refs.

23902 **(EPRI-NP—6240) The EPRI knowledge acquisition workshop handbook: Final report.** Groundwater, E.H.; Kirk, D.B.; Murray, A.E.; Stottler, R.H.; Dodd, D.D. (Electric Power Research Inst., Palo Alto, CA (USA); Science Applications International Corp., McLean, VA (USA)). Feb 1989. 110p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

This handbook discusses concepts and techniques for knowledge engineering an expert system. Expert systems are computer programs which replicate the reasoning of experts in some domain through the use of artificial intelligence programming techniques. The handbook focuses primarily on the acquisition of knowledge and secondarily on the representation of the knowledge acquired. Knowledge acquisition includes techniques for extracting knowledge from text and eliciting knowledge from experts. Knowledge representation issues include selecting the appropriate representation (rules, frames, networks, etc.) for your problem domain and verifying the correctness of the knowledge once it is encoded in the representation. This handbook was designed to be used in conjunction with other course materials in the Knowledge Acquisition Workshop conducted by Science Applications International Corporation for EPRI in the fall of both 1987 and 1988. The second workshop was videotaped, and this set of videotapes may be useful to the readers of this handbook. However, the handbook also was designed to be useful to persons conducting their own study in the field of knowledge engineering. Hopefully, it serves as a good overview and the references cited provide avenues for further study. 25 refs., 4 figs., 3 tabs.

23903 **(ICEFIZ-NP—59-1987) Advanced IPNE data acquisition system.** Duma, M.; Moisa, D.; Petrovici, M.; Berceanu, I.; Ivascu, M.; Pascovici, G.; Simion, V.; Osvath, E.; Bock, R.; Gobbi, A. (Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania)). (Central Inst. of Physics, Bucharest (Romania)). May 1987. 9p. NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706016/JAW.

A complex and flexible data acquisition system has been developed in order to run relative complex experiments in our acceleration system - ALIGATOR. AIDA programme has been carried out on a small PDP - 11/34 computer and is based on a CAMAC hardware. The main hardware and software features are presented. (authors).

23904 **(INIS-BR—1440, pp 51) SPEKT computer program and neutron spectra analysis from /sup 252/Cf.** Cabral, S.C.; Suita, J.C.; Lesiecki, H.; Klein, H. 1987. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS. Order Number DE88705763/JAW.

In Annual technical report -1987- Nuclear Engineering Institute - Dept. of Physics.

Published in summary from only.

23905 **(IPPJ-DT—142) CAMAC driver software on MS-DOS for the NEC PC-9801 personal computer.** Kojima, Mamoru; Hidekuma, Sigeru. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1988. 96p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88757241/JAW.

CAMAC Driver Software on MS-DOS for the NEC PC-9801 Personal Computer has been developed by the LABCOM group in order to use 'CAMAC' easily and efficiently. High-level language interfaces for the CAMAC Driver are designed much the same as the Fortran libraries of Kinetic Systems 2160 CAMAC driver software. The characteristics of the CAMAC Driver are as follows: (1) Any language, such as Fortran, C, and Basic, can call the CAMAC Driver routines as the same procedure. (2) The CAMAC Driver has a 'List Mode' operation. Therefore, CAMAC operations are rapidly executed with even high-level language. (3) The CAMAC Driver has a LAM-Interrupt function. After an interrupt transaction, an asynchronous subroutine is called from the interrupt program. Even when the Basic Interpreter is used, CAMAC operations are transacted rapidly and easily.

23906 **(JINR—R-10-88-94) On histogram optimization problem for spectral distributions.** Zlokazov, V.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1988. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706254/JAW.

Submitted to the journal Nucl. Instrum. Methods.

The paper describes a method of the optimization of the selection of parameters of a histogram(bin) for a very large class of regressions - those of spectral distributions is described. It is shown that for a regression s(x) the minimal statistical errors are given by bins of equal weights; they are such intervals Xk that the integrals of s(x) over them are equal for any pair of indexes (k, j), j not = k; whereas the minimal errors of the representation of a function by a histogram are obtained, when the abscissa of any histogram ordinate is assigned to the value, where the function is equal to its integral mean (while using the quadratic metrics) or to the amplitude mean (while using the uniform metrics). In both cases this abscissa may differ from the middle of the bin. The described method of the optimation has been applied to the most frequently used models of spectral functions - exponential, Gaussian and Lorentzian. 1 ref.

23907 **(LA-UR—88-3281) The multigroup and cylindrical geometry formulation of the Sn/Monte Carlo hybrid method.** Baker, R.S.; Filippone, W.L.; Alcouffe, R.E. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 10p. (CONF-890438—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89000326/JAW.

From American Nuclear Society meeting; Santa Fe, NM, USA (9 Apr 1989).

We describe a general formulation of the Sn/Monte Carlo hybrid method which couples a region where a Monte Carlo calculation has been performed to regions where Sn calculations are to be done. This coupling is completely consistent in that the solution obtained is not dependent upon any assumptions of geometric separation or decoupling. In this paper we demonstrate this consistency both theoretically and through example problems in R-Z cylindrical geometry and in the multigroup case. We have also reformulated the method to handle multigroup problems with a minimum impact upon storage requirements. As such we conclude that we have brought this method to the verge of solving practical problems in neutral particle transport. The hybrid technique consists of defining spatial regions of a problem in which either a Monte Carlo calculation or an Sn calculation is to be done. The calculations are then connected through the common boundary fluxes which are determined iteratively using the response matrix technique. The hybrid method is being developed so that the best features of the Monte Carlo and Sn techniques can be exploited in a single problem. It is advantageous to use precalculated response matrices in the Monte Carlo regions but not in the Sn regions. However, because the response matrices are stored, a brute force extension of the hybrid method to multigroup problems would increase the number of response matrix elements by a factor of G^2, where G is the number of energy groups. This quickly leads to unacceptable amounts of storage requirements. To address this, we have reformulated the method for multigroup problems which makes it possible to solve pure down scatter problems without significant increases in memory requirements.

23908 **(LA-UR—89-314) Exploring parallel algorithms having no serial analogues.** Hiromoto, R. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-48. 21p. (CONF-8810280—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007754/JAW.

From Workshop on methods and algorithms for PDE's on advanced processors; Austin, TX, USA (17 Oct 1988).

The ordering of data acquisitions in many computational problems is an artifact of algorithms developed for serial computers. Often these serial algorithms are highly parallel and thus are mapped directly onto a parallel processing system. This technique, however, does not fully exploit the additional opportunities provided by the system's parallelism. The design of optimal parallel algorithms requires new and different techniques and insights. Unfortunately, parallel performance can still be degraded even with optimal parallel algorithms that preserve the ordering of data access (that is, the data dependences between different computational code blocks) by synchronization primitives, such as locks, events, and barriers. Furthermore, additional decreases in performance are introduced by the various hardware/software components integrated to coordinate the particular parallel processing system. An alternative approach to the class of parallel iterative algorithms is to ignore the ordering of data accesses and allow the computational algorithm to execute asynchronously. These algorithms are referred to as chaotic algorithms and provide programming strategies that would otherwise be too cumbersome to implement and too inefficient to execute on a sequential processor. Although chaotic algorithms are difficult to analyze formally, the comparisons of their observed performance could lead to improved serial and deterministic (nonchaotic) parallel schemes. This paper will examine several chaotic iteration schemes and, based on their results, offer an alternative scheme that substantially improves the serial time to execute this algorithm. 11 refs., 11 figs.

23909 **(LA-UR—89-443) The power of digital audio in interactive instruction: An unexploited medium.** Pratt, J.; Trainor, M. (Los Alamos National Lab., NM (USA)). 1989. Contract W-7405-ENG-36. 11p. (CONF-890281—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89007758/JAW.

From 7. conference of the interactive instruction delivery; Orlando, FL, USA (22 Feb 1989).

Widespread use of audio in computer-based training (CBT) occurred with the advent of the interactive videodisc technology. This paper discusses the alternative of digital audio, which, unlike videodisc audio, enables one to rapidly revise the audio used in the CBT and which may be used in nonvideo CBT applications as well. We also discuss techniques used in audio script writing, editing, and production. Results from evaluations indicate a high degree of user satisfaction. 4 refs.

23910 **(LBL—24106) Incorporation of a boundary condition to numerical solution of POISSON's equation.** Caspi, S.; Helm, M.; Laslett, L.J. (Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract AC03-76SF00098. 8p. (CONF-890479—6). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number TI89007132/JAW.

From 7. international conference on finite element methods in flow problems; Huntsville, AL, USA (3 Apr 1989).

Two-dimensional and axially-symmetric problems in electrostatics, magnetostatics or potential fluid flow frequently are solved numerically by means of relaxation techniques -- employing, for example, the finite-difference program POISSON. In many such problems, the "sources" (charges or currents, vorticity, and regions of permeable material) lie exclusively within a finite closed boundary curve and the relaxation process, in principle, then can be confined to the region interior to such a boundary -- provided that a suitable boundary condition is imposed on the solution at the boundary. This paper is a review and illustration of a computational method that uses a boundary condition of such a nature as to avoid the inaccuracies and more extensive meshes present when, alternatively, a simple Dirichlet or Neumann boundary condition is speci-

fied on a somewhat more remote outer boundary. 2 refs., 5 figs., 1 tab.

23911 **(LBL-PUB—3076) IBM/VAX Gateway user's guide.** Rosenthal, E. (Lawrence Berkeley Lab., CA (USA)). Feb 1989. Contract AC03-76SF00098. 36p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009221/JAW.

The "Gateway User Guide" describes the facility available for transferring files from the Data Processing Services IBM mainframe to the Computer Services VAX/VMS cluster. This guide will benefit both Data Processing Operations Staff and programmers who would like to know more about how the "Gateway" operates and how to take advantage of its capabilities. The main focus of discussion will be on "how to" after a brief overview of the hardware and software components. A special section concerning the IBMRJE login shows how to use the VAX/VMS system to advantage. Source codes for all the procedures and DCL programs is provided at the end, as well as references made in this document to other sources. This first section of document will present a hardware and software overview of the current configuration.

23912 **(NAL-TM—583) Architecture simulator of parallel processor.** Harada, Koichi. (National Aerospace Lab., Chofu, Tokyo (Japan)). Mar 1988. 18p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88757167/JAW.

The parallel processor having been assumed as one of the typical forms of future supercomputer, its usefullness for the clarification of physically technological phenomenon in the aerospace was verified. On the supposition that it could be operated by a 22 MHz clock, and actually equiped with an IMFLOPS computing element and 128 KB memory storage in an approx. 2 cm x 2 cm x 100 cm space, by juxtaposing totally 128 x 256 units of thus supposed parallel processor, a parallel processor totally having a 32 FELOPS processing in performance was assumed. An architecture simulator, operating with the numerical simulator in the National Aerospace Laboratory and simulating, by clock unit, the operation of parallel processor, was developed. An applied program was adopted to the parallel processor and rewritten with the order system of parallel processor. The rewritten applied program being traced per respective order by the architecture simulator, the contending and computing element of readont/write request to the memory storage was studied in operational condition and evaluated in performance. (15 figs, 3 tabs, 12 refs)

23913 **(ORNL/CSD/TM—264) VAX/VMS file protection on the KSV VAXes.** (Oak Ridge National Lab., TN (USA)). Mar 1989. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008973/JAW.

This manual is a guide to use of the file protection mechanisms available on the Martin Marietta Energy Systems, Inc. KSV VAXes. User identification codes (UICs) and general identifiers are discussed as a basis for understanding UIC-based and access control list (ACL) protection.

23914 **(ORNL/TM—10991) Reduction of a general matrix to tridiagonal form.** Geist, G.A. (Oak Ridge National Lab., TN (USA)). Mar 1989. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008980/JAW.

This report reviews recent research in finding eigenvalues of general matrices by first reducing the matrix to tridiagonal form and then applying LR iteration to this reduced form. The report also describes a new algorithm for solving this problem and shows why it is superior to the other approaches. While our results show the algorithm to be over three times faster than the EISPACK routines for finding eigenvalues, there are some matrices for which the algorithm fails. The report describes how to detect these matrices during the reduction process and how to attempt to proceed. 13 refs., 7 figs., 1 tab.

23915 **(PNL-SA—16115) An integrated information support system for the factory floor of an ammunition manufacturing plant.** Schroeder, J.O.; Badalamente, R.V.; Crow, V.L. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1988. Contract AC06-76RL01830. 14p. (CONF-8811184—1). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009156/JAW.

From AutoFact '88; Chicago, IL, USA (2 Nov 1988).

An integrated information support system provides information processing and management on the factory floor of an ammunition manufacturing plant. The system is designed as a distributed network of minicomputers, process control computers and personal computer workstations that interactively update a complex relational database. The system controls and analyzes production,quality, and maintenance functions. Attention to human factors engineering during design has resulted in minimum training time and high user acceptance. The paper presents the system's life-cycle history and a critique of the implementation approach and system design. 3 refs., 4 figs.

23916 **(SAND—87-8244) INTERP---A Fortran callable free format data interpretation subroutine system.** Perano, K.J.; Kaliakin, V.N. (Sandia National Labs., Livermore, CA (USA)). Mar 1989. Contract AC04-76DR00789. 115p. NTIS, PC A06/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009000/JAW.

INTERP is a free format data interpretation subroutine system for lexical analysis. This system, written in ANSI standard FORTRAN 77, is flexible, easy to use, small, and efficient. These qualities make the addition of INTERP to an application program quite simple. INTERP operates both in interactive and batch environments on micro, supermini, and supercomputers. INTERP is currently being used to implement problem oriented language translators for both engineering analysis codes and utility programs. In addition, INTERP provides the foundation for the COMPRO command processor---a user interface system which greatly simplifies the task of implementing a command language. 2 figs., 10 tabs.

23917 **(SAND—88-1074) A procedure based on sensitivity data for testing for the equality of two means.** Hall, I.J.; Pierce, K.G. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1989. Contract AC04-76DP00789. 17p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008993/JAW.

Sensitivity testing is commonly applied to testing situations in which a test item either responds or does not respond to a certain stress level. Thus, at the end of a test, the experimenter does not know the exact minimum stress level required to make the test unit respond. Several testing and analyzing procedures have been developed to make estimates of the parameters of the stress level distribution. In this paper we give a procedure based on sensitivity data for testing for the equality of the means of two populations along with power curves for three different testing situations. 8 refs., 3 figs.

23918 **(SAND—88-2347C) Automating the identification of structural model parameters.** Allen, J.J.; Martinez, D.R. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1989. Contract AC04-76DP00789. 29p. (CONF-8904112—3). NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89006327/JAW.

From 30. structures, structural dynamics and materials conference; Mobile, AL, USA (3 Apr 1989).

System identification methods are analytical techniques for resolving the correct model form and parametric values. However, for system identification to become a practical tool for engineering analysis, the estimation techniques/codes must communicate with finite element software packages, without intensive analyst intervention and supervision. This paper presents a technique used to integrate commercial software packages for finite element modeling (MSC/NASTRAN), mathematical programming techniques (ADS), and general linear system analysis (PRO-MATLAB). The parameter estimation techniques and the software for controlling the overall system were programmed in PRO-MATLAB. Two examples of application of this software are presented. The examples consist of

a truss structure in which the model form is well defined and an electronics package whose model form is ill-defined since it is difficult to model with finite elements. A comparison of the resulting updated models with the experimental data showed significant improvement. 19 refs., 8 figs., 2 tabs.

23919 **(SAND—88-3114) Implementing security measures for computer-based security systems.** Faculjak, D.A. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1989. Contract AC04-76DP00789. 55p. NTIS, PC A04/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008995/JAW.

The purpose of this document is to ensure that system designers (a) become familiar with security issues, policy, and directives and (b) are able to integrate protection of the computer, its peripherals, and its data into the system at an early stage in its design. This document provides a comprehensive and uniform review of those security issues that are pertinent to the applications developed within Directorate 5200. The intention of this document is to provide guidance in the development of appropriate computer security protection for the SNLA-developed security systems. The policies and standards of computer security, set forth by the Department of Defense (DOD) and the DOE, are provided to enhance the designers' understanding of the rationale for such security.

23920 **(SAND—88-3478) Solid modeling requirements for finite element modeling using mapped mesh techniques.** Chavez, P.F. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1989. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009639/JAW.

A three-dimensional mesh generation project is progressing in the CAD Technology Division at Sandia National Laboratories. The project goals are to provide advanced geometric modeling capabilities with automatic discretization routines for finite element model creation. The project supports finite element analysis activities conducted at Sandia. Typical analyses performed include linear and non-linear structural, linear and non-linear thermal, and hydrodynamic calculations. The use of quadrilateral and hexahedral finite elements is the common thread in this broad spectrum of analysis. Our effort is designed to produce finite element models exclusively composed of quadrilateral or hexahedral elements. Our mesh generation work is being accomplished with the PADL2 [BROW82] solid modeler developed by Production Automation Project personnel at the University of Rochester. PADL2 has served as the basis for several commercial modelers. The mesh generation work is progressing from prototype development to a production environment. We desire to interface the mesh generator with other solid modelers that offer additional functionality and robustness. This paper identifies requirements that must be satisfied by solid modeling systems to support finite element mesh generation developments. Although these requirements are based on our finite element modeling effort, it is obvious that many of them are generic to a variety of applications. 9 refs., 6 figs.

23921 **(SAND—89-0170) User/programmer guide for EPXS: An expert system.** Fox, B.T. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1989. Contract AC04-76DP00789. 24p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008996/JAW.

An expert system developed to provide assistance to those involved with the creation, modification, interpretation and maintenance of Sandia's Engineering Procedures is described. 6 refs., 2 figs.

23922 **(SAND—89-0576C) Hierarchical object class representation using holes and notches.** Osbourn, G.C. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 9p. (CONF-890376—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008276/JAW.

From SPIE conference on advances in image compression and automatic target recognition; Orlando, FL, USA (30 Mar 1989).

A general representation approach is described which employs a hierarchy of holes and notches. A matching procedure is also described which allows non-ideal image hierarchies to be matched to class representations. The representation and matching methods are demonstrated on a set of handgun photographs. Examples of handguns which are different in detail are shown to exhibit the same class characteristics, while other similarly shaped objects are correctly distinguished from the handgun class. 6 refs., 8 figs.

23923 **(SAND—89-0580C) Two time stepping algorithms for parallel computers.** Womble, D.E. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 5p. (CONF-890372—2). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008679/JAW.

From 4. hypercube, concurrent computers and applications; Monterey, CA, USA (6 Mar 1989).

Time stepping algorithms are often used to solve parabolic and hyperbolic differential equations numerically. These algorithms are generally regarded as sequential in time; that is, the solution on a time level must be known before the computation of the solution at subsequent time levels can start. While this remains true in principle, we demonstrate that it is possible for processors to perform useful work on many time levels simultaneously. Specifically, it is possible for a processor assigned to a "later" time level to compute a very good initial guess for the solution based on approximations to the solutions on "previous" time levels, thus reducing the time required for solution. The reduction in the solution time can be measured as parallel speedup. We demonstrate two parallel time stepping algorithms that can be used for both linear and nonlinear problems. We compare the two algorithms and discuss their performance in terms of parameters associated with classical time stepping algorithms. 4 refs., 5 tabs.

23924 **(SAND—89-0581C) Factoring very large numbers using a massively parallel computer.** Holdridge, D.B.; Davis, J.A. (Sandia National Labs., Albuquerque, NM (USA)). 1989. Contract AC04-76DP00789. 3p. (CONF-890372—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008198/JAW.

From 4. hypercube, concurrent computers and applications; Monterey, CA, USA (6 Mar 1989).

A good many words have been spoken and written (some by the present authors) about factoring very large numbers. Therefore, the thrust of this paper is a discussion of how the quadratic sieve algorithm has been adapted to work on a 1024-processor hypercube at Sandia National Laboratories. A brief description of the hypercube, an NCUBE/ten, its idiosyncrasies and its power, as well as some comparisons of timings between numbers factored on the CRAY and on the hypercube, are included. 6 refs., 1 tab.

23925 **(TRI-PP—88-96) A tomograph VMEbus parallel processing data acquisition system.** Wilkinson, N.A.; Atkins, M.S.; Rogers, J.G. (TRIUMF, Vancouver, British Columbia (Canada)). Nov 1988. 5p. (CONF-881103—50). NTIS (US Sales Only), PC A02/MF A01 - OSTI. Order Number DE89007649/JAW.

From IEEE nuclear science symposium; Orlando, FL, USA (9 Nov 1988).

This paper describes a VME based data acquisition system suitable for the development of Positron Volume Imaging tomographs which use 3-D data for improved image resolution over slice-oriented tomographs. The data acquisition must be flexible enough to accommodate several 3-D reconstruction algorithms; hence, a software-based system is most suitable. Furthermore, because of the increased dimensions and resolution of volume imaging tomographs, the raw data event rate is greater than that of slice-oriented machines. These dual requirements are met by our data acquisition system. Flexibility is achieved through an array of processors connected over a VMEbus, operating asynchronously and in parallel. High raw data throughput is achieved using a dedicated high speed data transfer device available for the VMEbus. The device can attain a raw data rate of 2.5 million coincidence events per second for raw events which are 64 bits wide. Real-time data acquisition and pre-processing requirements can be met by about forty 20 MHz Motorola 68020/68881 processors. 22 refs., 5 figs.

23926 (UCID—21652) PixMail: Pictures through mail. Blattner, M.; Sierra, F.; Prassinos, P. (Lawrence Livermore National Lab., CA (USA)). Feb 1989. Contract W-7405-ENG-48. 13p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009682/JAW.

PixMail is a set of procedures for sending pictures through internet mail. The pictures can be sent or received by personal computers, terminals with or without raster capability, and facsimile machines. Optical scanners may be used as input to the picture file and printers may be used as an output device once the raster file is stored in a form used by a paint editor. No additional equipment needs to be purchased by the users to send or receive PixMail (unless facsimile input/output is desired) and it is no more difficult to send or receive than ordinary UNIX mail. PixMail uses the protocols of existing electronic mail for transmission from any ARPAnet or MILnet user to any other. 15 refs., 1 fig.

23927 (UCRL—21171) Development of OMS [Online Mathematical System] as an interactive post-processing system: Final report, July 1, 1987--December 31, 1988. Fried, B.D.; Ferraro, R.D. (California Univ., Los Angeles (USA). Dept. of Physics). 14 Dec 1988. Contract W-7405-ENG-48. 4p. NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009234/JAW.

All of the tasks listed in our proposal for transporting the UCLA Online Mathematical System (OMS) to the NMFECC Crays have been completed. This has involved the specific refinements and additions of capability to the original portable (PC) version of OMS, which is now operational on all of the NMFECC Crays and is discussed in this report.

23928 (UCRL—98873) A new approach to system testing. Storch, N. (Lawrence Livermore National Lab., CA (USA)). 1 Jun 1988. Contract W-7405-ENG-48. 7p. (CONF-880894—4). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008660/JAW.

From Structured development forum X; San Francisco, CA, USA (8 Aug 1988).

This paper describes actual experiences in designing system level test cases for a large on-line commercial transaction system which had just been implemented. Real world, less than perfect conditions existed. Although software engineering methods had been during the development, up-to-date available documentation was limited as was the availability of knowledgeable persons. Even so, test cases were needed in a timely fashion. An approach was taken to identify a major section of the software as an object and then to develop a state model for it based on the implementation and availability of certain process information in the database such as: track flags, status, and time stamps. A flow graph was derived from the state transition diagram. Application of basis path testing to a simplified version of the flow graph lead to a meaningful set of test cases which when run found errors. Not only was this testing a success, but the creation of the state model provided valuable documentation for further understanding and maintenance of the software. 4 refs., 2 figs.

23929 (UCRL—98924) Storage in supercomputer environments. Coleman, S. (Lawrence Livermore National Lab., CA (USA)). 1 Jun 1988. Contract W-7405-ENG-48. 8p. (CONF-8804136—3). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008895/JAW.

From Cray Users Group meeting; Minneapolis, MN, USA (26 Apr 1988).

The demand for storage in supercomputer environments is increasing and forcing an evolution toward distributed storage systems. In this paper, I will describe some existing storage systems and some requirements for future systems. I will also describe the Storage Reference Model being developed by the IEEE Computer Society and a new storage system being developed at Livermore according to the IEEE model. 12 refs., 6 figs.

23930 (WHC-SA—0504) Fourth generation computer languages. Lewis, B. (Westinghouse Hanford Co., Richland, WA (USA)). Jan 1989. Contract AC06-87RL10930. 6p. (CONF-890194—1). NTIS, PC A02/MF A01 - OSTI; 1; GPO Dep. Order Number DE89008800/JAW.

From Association for Energy Systems operations and procedures conference; Berkeley, CA, USA (17 Jan 1989).

The role of Fourth Generation Languages (4GL) has changed dramatically during the last five years. The 4GLs were initially limited to end-user needs in a homogeneous environment. Now their intent is to work in heterogeneous environments and far surpass traditional end-user roles.

23931 Digital waveform sampling rate converter. Feibig, P.L.; Brown, L.I.; Etter, D.M. (Department of Electrical and Computer Engineering, University of New Mexico, Albuquerque, New Mexico 87131). *Computers in Physics;* **3**: No. 3, 38-41(May 1989).

The digital waveform sampling rate converter is an efficient, easy-to-use software system that allows a user to perform the conversion between sampling rates efficiently and accurately. The user does not need to be concerned with the technical details of the package. The user simply needs to answer the questions presented by the package, specifying certain input and output files. The software takes care of the conversion. The user can easily verify that a desired file has been selected by choosing the option to plot the signal. This package succeeds in making the mathematical process for sampling rate changes efficient and effortless. UFRULE1

23932 Spline algorithms for continuum functions. Froese Fischer, C.; Idrees, M. (Department of Computer Science, Vanderbilt University, Nashville, Tennessee 37235). *Computers in Physics;* **3**: No. 3, 53-58(May 1989).

Spline algorithms are described for solving the radial equation for continuum states. The Galerkin method leads to a generalized eigenvalue problem for which the eigenvalue is known so that inverse iteration can be used to determine the eigenvector. Three cases are considered: the equation whose solution is sin κr, the Coulomb problem, and the hydrogen scattering problem. Plots are presented for the first two cases that show the dependence of the error in the phase shift on spline parameters and execution time. The results for the scattering problem are compared with earlier values.

23933 Gaussian random number generators on a CYBER-205. Black, S.C.; Kennedy, A.D. (Department of Physics, Florida State University, Tallahassee, Florida 32306). *Computers in Physics;* **3**: No. 3, 59-68(May 1989).

Normally distributed pseudorandom numbers are needed for many applications. Simple procedures for producing such a distribution can be found in many standard mathematical libraries. When many numbers are needed, however, the relatively slow speed of these methods can be a serious drawback. This is especially true on a vector computer, where the standard libraries contain scalar routines. The vectorization of several Gaussian random number generators on a CDC CYBER-205 is discussed. Four methods for producing a normal distribution are reviewed in detail. The first two considered are simple algorithms often referred to by the same name, the polar method. The latter two are more complex procedures which speed up the generating process by dividing the normal distribution into various parts. These are the rectangle--wedge--tail and ziggurat methods. Implementation on a CYBER-205 of the rectangle--wedge--tail, ziggurat, and one of the polar methods is discussed in detail. In evaluating their performance, it is found that the rectangle--wedge--tail and ziggurat methods offer significant improvements in execution speed over the polar method. Of these two, the ziggurat method is appreciably faster and requires fewer auxiliary constants. If only a few random numbers are needed, however, the polar method is probably the best choice. It may be coded in a few lines, and the sacrifice in speed is found to be only about a factor of 3.

23934 Parallel processing of random number generation for Monte Carlo turbulence simulation. Koniges, A.E.; Leith, C.E. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Computational Physics;* **81**: No. 1, 230-235(Mar 1989).

A method is given of obtaining reproducible sets of pseudorandom numbers for Monte Carlo Plasma simulation calculations. (AIP)

23935 **Multilevel variational method for Au = λBu on composite grids.** Mandel, J.; McCormick, S. (Computational Mathematics Group, Campus Box 170, University of Colorado at Denver, 1200 Larimer Street, Denver, Colorado 80204). *Journal of Computational Physics;* **80**: No. 2, 442-452(Feb 1989).

There are two existing general approaches to the numerical solution of differential eigenproblems by multigrid, one which uses a linear multigrid solver for the inner loop of a linearization technique (e.g., inverse iteration) and the other which integrates multigrid directly into the problem solution (e.g., FAS). The present paper develops a third multigridlike approach, RQMG, that appeals directly to the variational problem of minimizing the Rayleigh quotient, applying easily to both global and local grid implementations. Numerical results are presented for a simplified single group diffusion problem. copyright 1989 Academic Press, Inc.

23936 **Calculation of Clebsch--Gordan and Racah coefficients using symbolic manipulation programs.** Klink, W.H.; Ton-That, T. (Department of Mathematics, The University of Iowa, Iowa City, Iowa 52242). *Journal of Computational Physics;* **80**: No. 2, 453-471(Feb 1989).

A procedure for calculating Clebsch--Gordan and Racah coefficients arising from the decomposition of n-fold tensor products of the U(N) groups using symbolic manipulation programs is given. Basic states are realized as polynomials in a space equipped with a differentiation inner product. The desired coefficients are then obtained by differentiating the relevant polynomials. Examples from SU(2) and SU(3) are given. copyright 1989 Academic Press, Inc.

23937 **Complex-plane methods for evaluating integrals with highly oscillatory integrands.** Davies, K.T.R. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6373). *Journal of Computational Physics;* **80**: No. 2, 498-505(Feb 1989).

A numerical method of evaluating integrals is presented that is based on the deformation of the contour of integration in the complex plane. (AIP)

23938 **Method and apparatus for bistable optical information storage for erasable optical disks.** Land, C.E.; McKinney, I.D. (to Dept. of Energy). US Patent Application 7-200,095. 31 May 1988. 30p. Contract AC04-76DP00789. DE89009663 NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009663/JAW.

A method and an optical device for bistable storage of optical information, together with reading and erasure of the optical information, using a photoactivated shift in a field dependent phase transition between a metastable or a bias-stabilized ferroelectric (FE) phase and a stable antiferroelectric (AFE) phase in a lead lanthanum zirconate titanate (PLZT). An optical disk contains the PLZT. Writing and erasing of optical information can be accomplished by a light beam normal to the disk. Reading of optical information can be accomplished by a light beam at an incidence angle of 15 to 60 degrees to the normal of the disk. 10 figs.

23939 **The application of expert systems to the analysis of logic trees.** Franklin, A.L. (Systems Analysis Section, Pacific Northwest Lab., Richland, WA (US)). pp v of Personal computer applications in the gas industry II. Bukacek, R.F. Chicago, IL; Institute of Gas Technology (1987). (CONF-870657—).

From 4. annual symposium on personal computer applications in the gas industry; Chicago, IL, USA (22 Jun 1987).

Fault tree analysis has been for many years a standard method of representing and communicating system failure information. Fault trees are a subset of logic trees, which use logical relationships (AND, OR and NOT gates) to represent logical relationships between system components and component behavior. Although logic tree concepts were developed specifically to enhance the organization and communication of system information, it is generally recognized that specially trained individuals are needed to both develop and analyze logic tree information. An application developed at Battelle's Pacific Northwest Laboratory for the U.S. Bureau of Mines uses artificial intelligence techniques to improve the availability of information contained in logic tree representations. FALTS (Failure Analysis and Logic Tree System) is a generalized knowledge-based system package designed to organize, identify, and communicate logic tree information. It is intended that FALTS be used as a predictive system for interfacing mine safety officials with the status and potential circumstances of mine operations. However, FALTS has been generalized to be used outside the mining industry and can also be used for diagnostic investigation to identify the most likely causes of known system and component failures.

9903 Information Handling

REFER ALSO TO CITATION(S) 22651, 23201, 23391, 23555

23940 **(DOE/AL/26034—T6) Final technology transfer report.** (New Mexico Technet, Inc., Albuquerque (USA)). 15 Jun 1988. Contract FG04-84AL26034. 19p. NTIS, PC A03/MF A01 - OSTI; 1; GPO Dep. Order Number DE89009044/JAW.

For the past year New Mexico Technet, Inc. (Technet), has been working with the national laboratories, the universities and private industry to develop ways in which Technet can be used to provide and enhance technology transfer. This final report will track our progress toward creating a technology transfer data base, establishing industry-laboratory pilot projects and identifying other types of assistance Technet can provide industry and state government. This report will follow the outline of the Scope of Work set forth in our contract with the Department of Energy. A chronology of progress is included, as well as written documentation of requests Technet has made to the laboratories and meetings Technet staff has held with industries, laboratories and universities. Following our discussion of the work undertaken this year, Technet will provide its conclusions on the strengths and weaknesses of the project, how we feel its mission can be continued, and suggestions the Department of Energy might make to its laboratories in the area of technology transfer through the new tools available in various states, including communications networks and technology foundations, such as Riotech.

23941 **(DOE/ER/25025—T1) Information technology and the conduct of research: The user's view.** (National Academy of Sciences, Washington, DC (USA). Committee on Science, Engineering, and Public Policy). 1989. Contract FG01-86ER25025. 84p. National Academy Press, 2101 Constitution Ave., N.W., Washington, DC 20418.

Information technology-the set of computer and telecommunications technologies that makes possible computation, communication, and the storage and retrieval of information-has changed the conduct of scientific, engineering, and clinical research. This report examines present trends, future potential, and impediments to the use of information technology in support of research. Written from the viewpoint of the researcher using information technology and including many examples, the report offers a number of recommendations directed to two principal audiences: policymakers and leaders of institutions responsible for the support and management of research, and researchers themselves.

23942 **(FEI—1878) On-line system for many-dimensional studies in nuclear and atomic physics.** Andriashin, A.V.; Gonchar, A.I.; Demenkov, V.G. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS. Order Number DE88706146/JAW.

A three-dimensional experiment is used as an example to develop a system for the multiparameter research. The system is based on the CAMAC standard with two levels of the hierarchic control: autonomous or local one controlled by the additional BAK-081 controller and central one controlled by the SM-1300 computer. The characteristics of the system and some results of the experiment performed on studying the processes of interaction of fission fragments with solid targets are given. The structure of the data and the algorithm of their preliminary sorting in considered. 6 refs.; 5 figs.

9904 Law

REFER ALSO TO CITATION(S) 22072

23943 **(INIS-XN—164) Ordinance of 30 November 1987 concerning the Paul-Scherrer Institute.** (International Atomic Energy Agency, Vienna (Austria)). 30 Nov 1987. 3p. (In French). NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS. Order Number DE88706191/JAW.

This Ordinance, which entered into force on 1 January 1988, provides for the merger of the Federal Institute for Reactor Research (IFR) and the Swiss Institute for Nuclear Research (ISN), both located on the opposite banks of the Aar river in the Argau canton, into a new research establishment, the Paul-Scherrer Institute. While the IFR and the ISN worked on fundamental research and applied research covering industrial applications respectively, the Paul-Scherrer Institute will be more of a multidisciplinary establishment for natural sciences and engineering. The Ordinance sets the statute, tasks, etc. of the Institute.